FEB 13 1912
PUBLIC LIBRARY
CITY OF DETROIT

POWER

Volume 35, No. 7.
Issued Every Tuesday.
Hill Publishing Company.

NEW YORK, FEBRUARY 13, 1912.

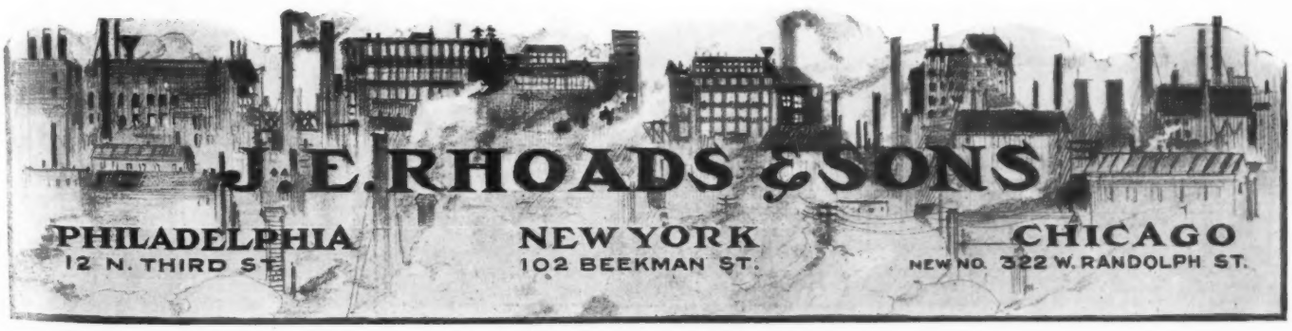
Price, 5 cents.
Outline of Topics, 58.
Index to Advertisers, 45.

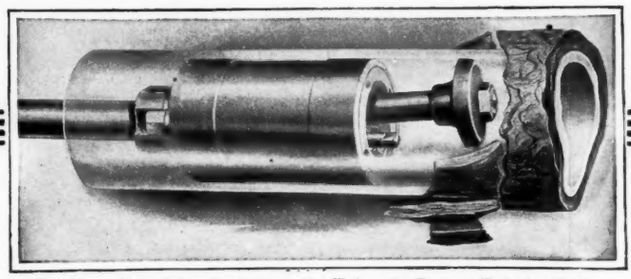
WHY do men pay the price for TANNATE? A sample suggests some of the reasons. Cut a slit 3/32 inch from the edge and tear it; then try a piece of oak belt. You will find out the Tannate's strength. It often outwears other belts two, three or four times. Feel its clinging surface. You could hardly make it slip if you wanted to. Bend it. Note its flexibility. It hugs the pulley close. All three points fit it for high speed drives. It transmits your power and speed with minimum loss and minimum stoppage for take-ups and repairs.

Tannate will hardly stretch at all. One 12-inch double Tannate Belt ran thirteen months without a take-up and that on a vertical drive where a previous belt had to be taken up at frequent intervals, and lasted only twelve months altogether. This matter of stretch is of vital importance. You want all the stretch taken out that can be done without weakening the belt. This we do before we cut it to width. Consequently, Tannate Belts hardly lose at all in width by stretching on your pulleys, and what is more important, they save you the expense of take-ups and much power usually lost by slippage. And they last far longer.

Write us for a sample.

Kindly give us also the name of your dealer.





The Dean Removing Scale from the Tube of a Return Tubular Boiler

The Engineer's Opportunity

Ten years ago the engineer looked upon boiler cleaning as a necessary evil.

Today, he recognizes it as an opportunity to make a showing.

It's a hard, nasty job to be sure, and it usually has to be done on a Sunday or a holiday.

But isn't it worth while if by keeping the tubes clean he can put an end to leaky and burned out tubes, get more steam from his boilers and make a saving of 10 to 40% on the fuel?

The fuel-saving ability alone which the

Dean Boiler Tube Cleaner

gives an engineer makes him stand in right with the Old Man and often brings him a raise in salary.

One of the first things an engineer on a new job does is to order a DEAN on trial. Why ?

Because he knows that of all cleaners it is the one device that will locate and remove scale.

And he wants to be sure that ALL the scale is taken out of his boilers, so he can make a good showing of results right from the start. Almost any cleaner will remove SOME scale but the DEAN will remove ALL of it. For it removes scale by vibration and it goes where no inspector can. It is bound to find scale if there is any to be found.

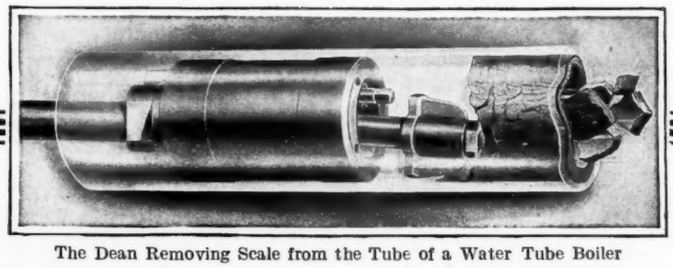
Don't YOU want to try the DEAN and find out what you can accomplish with it?

Free Trial Offer

We'll loan you a DEAN for free trial in one boiler. We won't hurry you with the test, force the cleaner on you, nor get sore if we don't effect a sale. We simply want you to see what a money-saving proposition we have. Then it's up to you to decide what to do with it.

THE WM. B. PIERCE CO.

Chicago Office: 801 Steinway Bldg. **Jewett Bldg., Buffalo, N. Y**



The Dean Removing Scale from the Tube of a Water Tube Boiler

KEYSTONE GREASE

KEYSTONE TRADE MARK REGISTERED U.S. PAT. OFF.

With Keystone

Users Everywhere

WE'VE a friend out in thriving town in the great middle west—Hans by name—who has lost none of the thorough-going ways of his German forefathers. Our salesman never misses an opportunity to call on Hans. "Satisfied as I never was before," is his constant statement with regard to Keystone Grease. And for Hans to be more satisfied than he was when we saw him a year ago, with his pipe and his hearty laugh, is to be perfectly content. But Keystone Grease will satisfy anyone—especially if, like Hans, his hobby is a neat, clean and well managed plant.

See, for yourself, if complete satisfaction and Keystone Grease don't go hand in hand. All that you need to do is to fill out and return the coupon and get a free Can of Keystone Grease, Free Grease Cup and Free Engineer's Cap. We're waiting to send them to you.

KEYSTONE LUBRICATING CO.

Executive Offices and Works

21st, Clearfield and Lippincott Streets Philadelphia, Pa.

Branch offices and warehouses in the principal cities of the United States.
Agencies in the principal countries throughout the world.

No Connection With The Oil Trust

A SAMPLE FREE

KEYSTONE LUBRICATING COMPANY, Phila.

Please send us a large size sample of Keystone Grease, sufficient for testing purposes, and one Brass Grease Cup and Free Engineer's Cap. It is thoroughly understood that no charges whatsoever will be made for sample, cup or cap, and all express charges will be paid by you.

Name of bearing where sample will be tested.....
Its width..... Combined horsepower of engines.....
Tap size of cup.....
FIRM.....
Per .....
City ..... State.....
Size cap required.....

CUT OUT THIS COUPON AND MAIL IT TO-DAY Dept. B—2-13-12

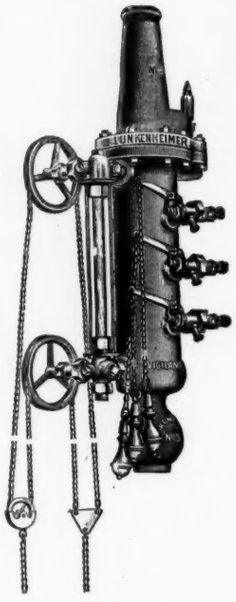


Fig. 990.
"Vigilant" Safety Water Column with "Excelsior" Gauge Cock and "Monitor" Water Gauge.

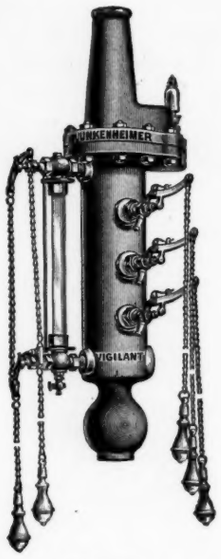


Fig. 991.
"Vigilant" Safety Water Column with Rotating Gauge Cocks and Quick-closing Water Gauge.

Fig. 919.
"Vigilant" Safety Water Column without Water Gauge or Gauge Cocks.

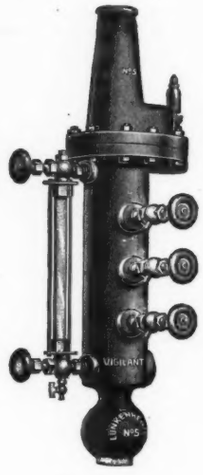


Fig. 989.
"Vigilant" Safety Water Column with Regrinding Gauge Cocks and Three-Rod Water Gauge.

Lunkenheimer
"Vigilant" Safety Water Columns

will prevent serious accidents by automatically sounding an alarm, and thereby notifying the boiler attendant, when the water in the boiler approaches the low or high danger limit.

By insuring a uniform water level, the "Vigilant" effects greater economy in the use of fuel, obviates expensive repairs and stoppages and lengthens the life of the boiler.

Only one strong, seamless copper float is used, and it is guaranteed not to collapse under 350 pounds of pressure per square inch.

The material used for the body and top is a high grade iron of close grain and great strength, while all parts subjected to wear and which are renewable, are made of a good bronze composition containing a large percentage of copper and tin. The columns are guaranteed for working pressures up to 250 pounds and are made in all sizes suitable for various types of boilers.

Specify and insist upon securing genuine Lunkenheimer make. Do not accept substitutes,—they are never as good as the genuine.

"MOST supply houses sell them—yours CAN—if they DONT or WONT—tell US."

THE LUNKENHEIMER COMPANY

Largest Manufacturers of High Grade Engineering Specialties in the World

General Offices and Works:
CINCINNATI, OHIO, U. S. A.

New York, 64-68 Fulton Street
London, S. E., 35 Great Dover Street
Boston, 138 High Street
Chicago, 186 N. Dearborn Street

10

The Economy Of Dearborn Treatment

Reduces Repair Bills

No scale can lodge on the boiler tubes and plates when Dearborn Treatment is used. Consequently overheating of metal is avoided, boiler strains are reduced, all danger of bagging is eliminated, and repair costs brought down to a minimum.

Dearborn Treatment not only is an efficient repair reducer but by keeping the heating surfaces clean continually it saves its cost many times over in coal saving, in time saving, in labor saving. It increases boiler capacity, prolongs boiler life, reduces boiler troubles.

Dearborn Treatment is so successful because in every case it is prepared to fit the exact feed water conditions of the plant to which it is shipped.

Send us a gallon of your feed water in a clean container. We'll analyze it and let you know cost of treatment that will put a complete stop to scale formation in your boilers. Send sample today.

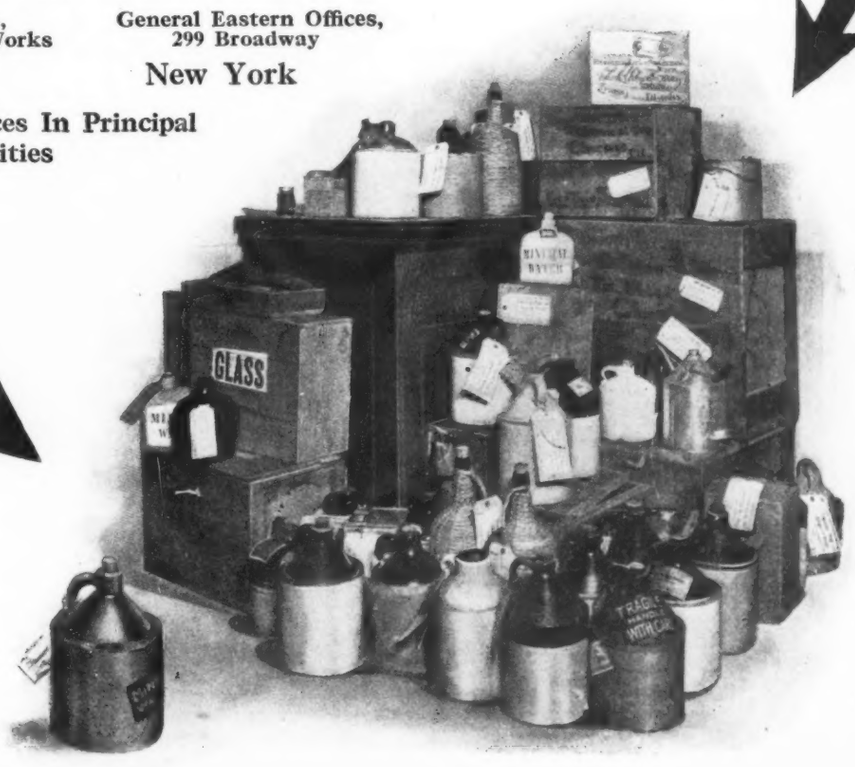
Dearborn Drug & Chemical Works,

Robt. F. Carr, Pres.

General Offices, Laboratories and Works
Chicago

General Eastern Offices, 299 Broadway
New York

Branch Offices In Principal Cities

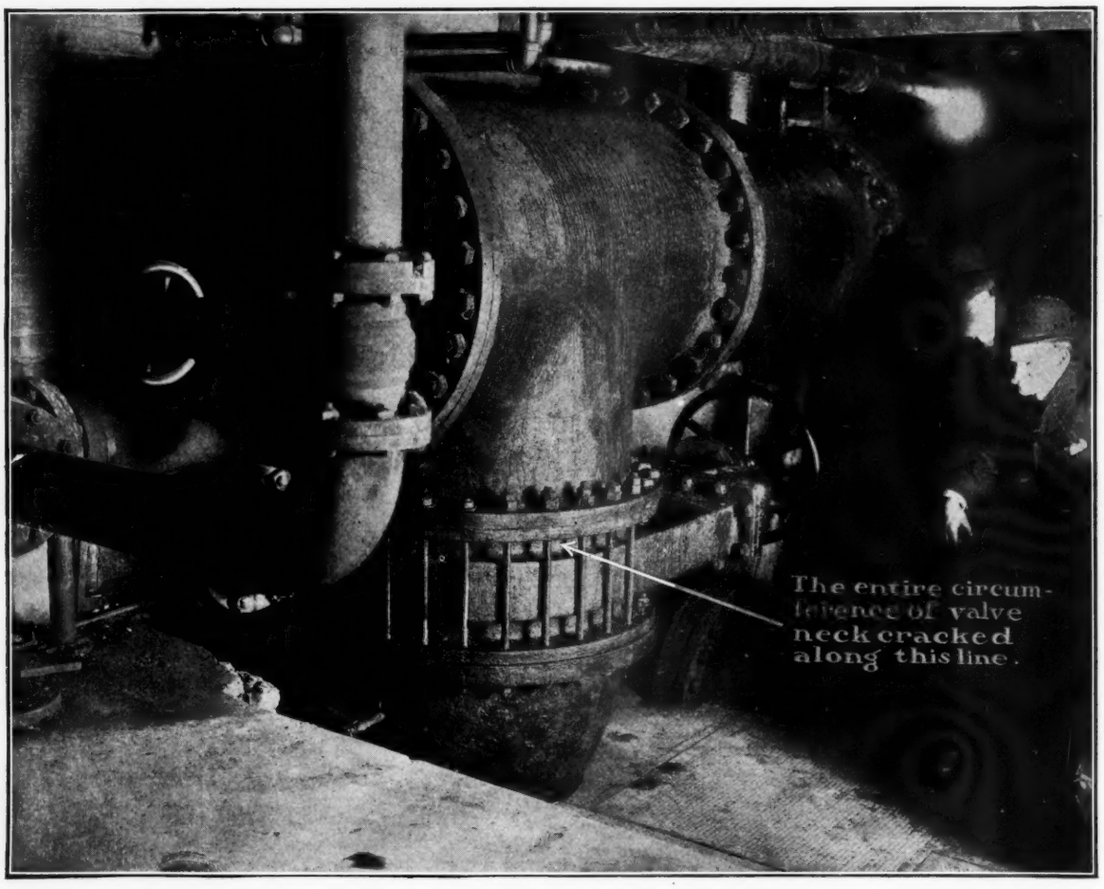


No. 3

SMOOTH-ON

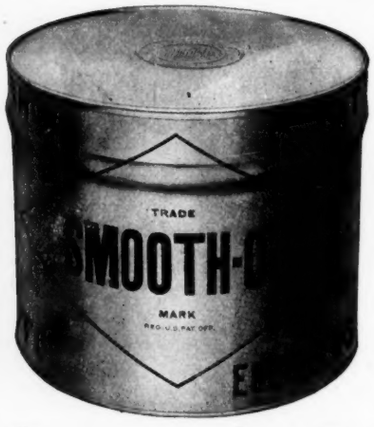
TRADE MARK

(Trade Mark Registered U. S. Patent Office.)



The Permanent Repairing Agent

Here is one SMOOTH-ON Performance



SOUTH SIDE ELEVATED R. R. CO.
POWER HOUSE, 40TH AND STATE STS.
CHICAGO, ILL., APRIL 10, 1908.

SMOOTH-ON MFG. CO., JERSEY CITY, N. J.
GENTLEMEN:

This photograph was taken from a 30″ Gate Valve which is in the 30″ suction line for the Condensers. This valve cracked all around under the top flange. I cleaned the crack, filled it with *Smooth-On Iron Cement No.* 1, put the rods across as shown in photo, and drew it together. This was done about two years ago, and it has been as good as new ever since.

Smooth-On is a very useful article in a power plant and I would not think of being without it.

Yours very truly,
(Signed) A. L. HADEN, CHIEF ENGINEER.

Sold in Blue Label Cans for cold work; Gray Label for hot work.
Send for our free Instruction Book.

Smooth-On Mfg. Co., 572-574 Communipaw Avenue, Jersey City, N. J., U. S. A.

Chicago, 61 N. Jefferson Street. San Francisco, 94 Market Street. England, 8 White Street, Moorfields, London, E. C.

POWER

Vol. 35 NEW YORK, FEBRUARY 13, 1912 No. 7

Some men take naturally to writing—they are "born writers." With others the task of putting their thoughts in black on white is one to be dreaded.

There is a distinct advantage in being a devotee to the art of letters, no matter whether you become especially proficient as a writer or not. For instance, a man who acquires the habit of writing up notes on his experiences and observations and on what he has read pertaining to his work, etc., is bound to profit in several ways. 'Tis true that "Reading maketh a full man, *writing* a *correct* man, * * * *" And correctness, or accuracy, is a cardinal virtue in engineering. The mere act of writing out his thoughts serves to fix them more securely in his mind.

Often an idea, when hastily or carelessly considered, may seem sound and true; but when the same idea comes to be written out its fallacies or weak points soon show up.

With writing, just as with almost everything else, it is practice that counts. It is said that such geniuses as Dante, Goethe, Macaulay and Darwin were seldom if ever satisfied with the first draft of anything they ever wrote; they continually made revisions and corrections.

This suggests, then, another benefit to be derived from practice at writing, to wit, mental discipline. To be always striving to improve upon what has previously been accomplished is a fine "fault."

Then, there is a direct material gain to be had from this practice. POWER is always glad to receive and consider manuscripts from any of its readers on any subject relating to the generation and transmission of power. If the idea embodied in a manuscript is good, the manuscript is accepted for publication and paid for. In such a case the writer is not only improving in experience, but he is actually getting paid for his practice as well.

For all who are familiar with the construction and operation of a turbine the present time offers a particularly bright opportunity to "pull down" some real money by entering the prize-article contest in POWER which closes on March 1.

The winner will not necessarily be the man who sends in the finest specimen of English composition. He will be the one whose manuscript contains such material that any intelligent engineer who had never seen a turbine before could use as a guide in successfully starting up and operating a turbine such as the particular manuscript deals with.

Even if you are not the winner, you will be paid for your manuscript if it is suitable for publication. Thus, in any event, your work need not be entirely for naught.

Plant of Capital Traction Company

By J. H. Beattie

The rapid increase in electric traction in Washington, D. C., is shown by the fact that the original plant of 2500 kw. capacity, built in 1898, was at the time considered much too large, whereas a new plant of 11,000 kw. capacity has just been completed for handling the increased overload.

For several years previous to 1898 the cars of the Capital Traction Co., of Washington, D. C., were operated by cable power, but in that year the destruction of the power house by fire led to a determination to install electric drive. The power plant installed was located on Grace St., in Georgetown, along the Chesapeake & Ohio Canal, and contained originally five 525-kw., Corliss engine-driven, direct-current units, the station having a total capacity of 2625 kw. This plant was described in POWER at the time, and the company was criticized by many for installing too much power.

By 1907, the demands for power had grown to such an extent that the plant was heavily overloaded, when two of the engines were taken out and two 1500-kw. Westinghouse turbines were installed; these were alternating-current machines. Again, in 1908, the plant was still further enlarged by the removal of another engine-driven unit and the substitution of a 3000-kw. turbo-generator. However, due to the adoption of double-truck cars and to extensions of the system, the power plant soon became inadequate.

The old plant was entirely dependent upon the Chesapeake & Ohio Canal for its supply of water, and a break in the Washington level of the canal at any time would have crippled it very seriously, if not causing a complete shutdown. In addition to this the plant relied upon the canal for its coal supply.

As the building was wholly unsuited to a further increase in the generating capacity, it was decided to build a new plant. This was authorized in January, 1910. Property was purchased at K and Thirty-second Sts., and extended to the river. This location was chosen for several reasons: In the first place, it insured an abundant supply of water for boiler-feed and condensing purposes; and, secondly, coal could be secured either from barges on the river or from the cars on a spur from the Georgetown branch of the Baltimore & Ohio R.R.

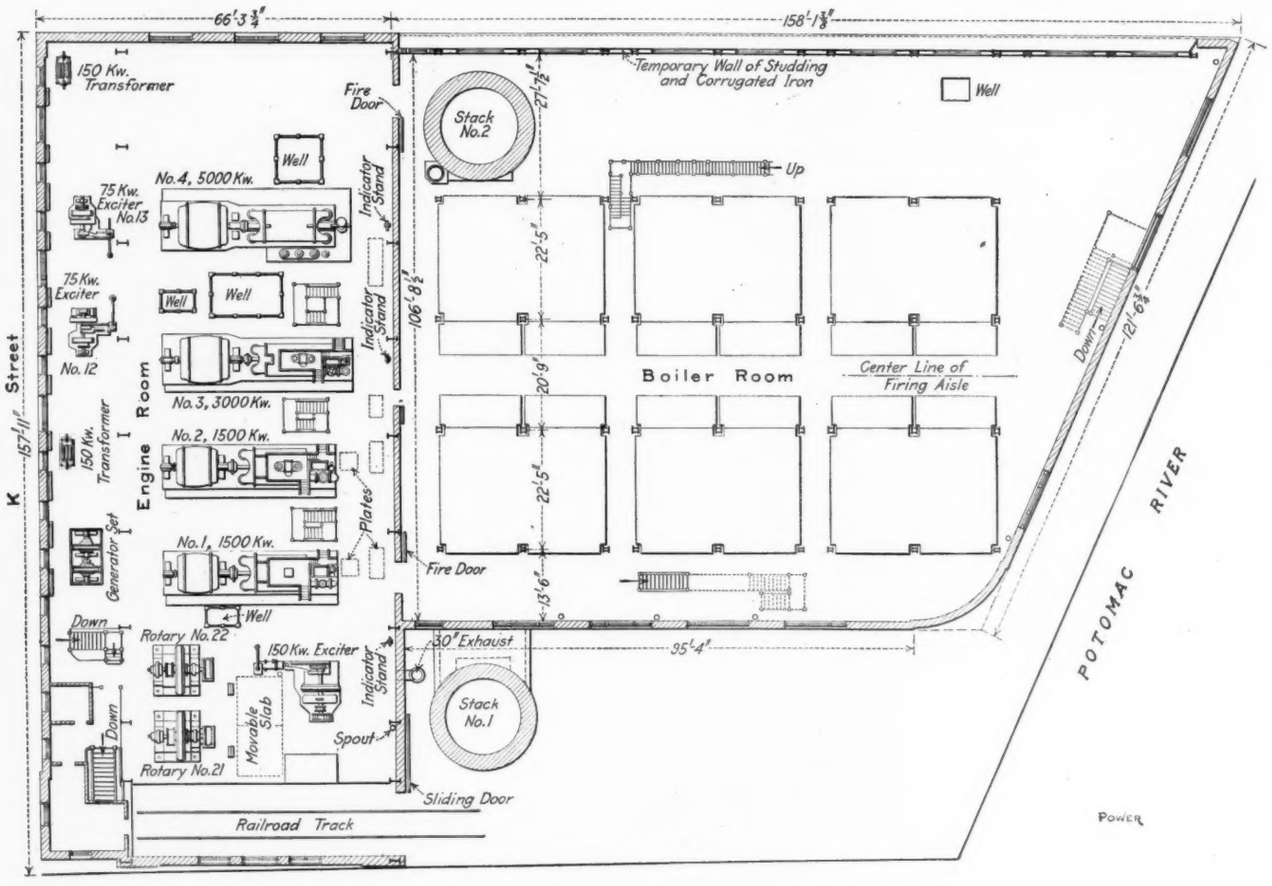


FIG. 1. GENERAL LAYOUT OF PLANT

THE NEW PLANT

The new plant was first put in operation about the middle of last September, and the old plant was practically abandoned a month later, although the removal of the boilers is now just about completed.

In building the foundation, it was necessary to drive a large number of piles to rock on the river side, while on the land side the foundation was dug out of solid rock. Also, on the river side a concrete wall was built which served as a support for the coal spur and the south building wall. A general plan of the plant is given in Fig. 1, which shows not only the part at present erected but also the provision which has been made for future extensions.

FOUNDATION AND SEA WALL

The foundation and sea wall are constructed almost entirely of concrete. The level of the basement floor is 1 ft. above mean high tide, while the turbine floor

is 4 ft. above the highest water ever known on the Potomac River. The basement floor and walls are thoroughly waterproof. The plant could operate under almost any conditions of high water due to a construction of the basement containing the condensers and the arrangement of the circulating pumps.

Boilers

The 12 boilers, which are of the Babcock & Wilcox type, each of 600 hp., are arranged in two rows with a common firing aisle between. Steam at 175 lb. pressure and 100 deg. superheat is carried. Eight of these boilers are new while four are from the Grace St. plant. They are all fitted with Roney stokers and have a grate area of 75 sq.ft. each; they are also fitted with soot blowers.

An interesting plan has been adopted in the boiler room to aid the firemen in taking care of the fires. This is a small track of 18 in. gage laid along the fronts of both rows and carrying a small car bearing a framework about 3 ft. high. This seems to be a great aid to the firemen as they are thus placed in a more advantageous position to handle the fires.

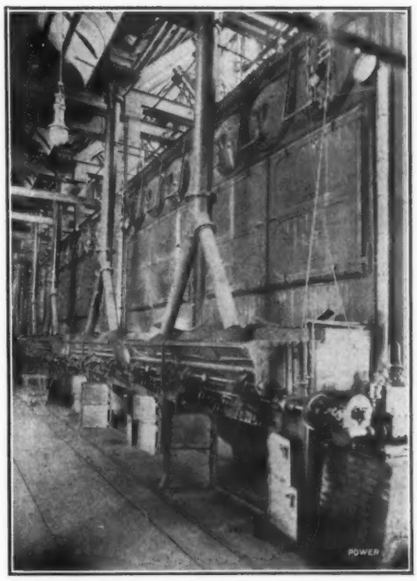


Fig. 2. Looking Down Firing Aisle

The sheet-steel breechings for the boilers are located in the basement immediately below the boiler room, one on each side extending the length of the room and connecting with its stack. The stacks are of the Alphons Custodis radial brick type, 11 ft. 1 in. internal diameter and 247 ft. high.

Steam Piping

The boiler nozzles are 8 in. and connect to a 12-in. header immediately back of the row of boilers. At the end of the boiler room this header drops to below the floor level, runs through the wall and connects to a 14-in. header running at right angles to this room and parallel to the turbine room. From this pipe the supply pipes of the various turbines are taken. Each boiler nozzle is fitted with a Foster valve so that, in case a tube blew out, the particular boiler to which the accident had occurred would be immediately cut off from the other boilers, thus protecting the plant from shutdown and lessening the danger to the attendants.

In addition to the main steam line, the auxiliary apparatus is supplied with saturated steam from a 6-in. pipe line. All steam piping is heavily lagged with 85 per cent. magnesia covering.

A rather elaborate drip system has been installed by which the drips from the entire high-pressure system are led to two central tanks in the basement provided with automatically operated pumps, whereby the water is returned to the boiler feed as it accumulates.

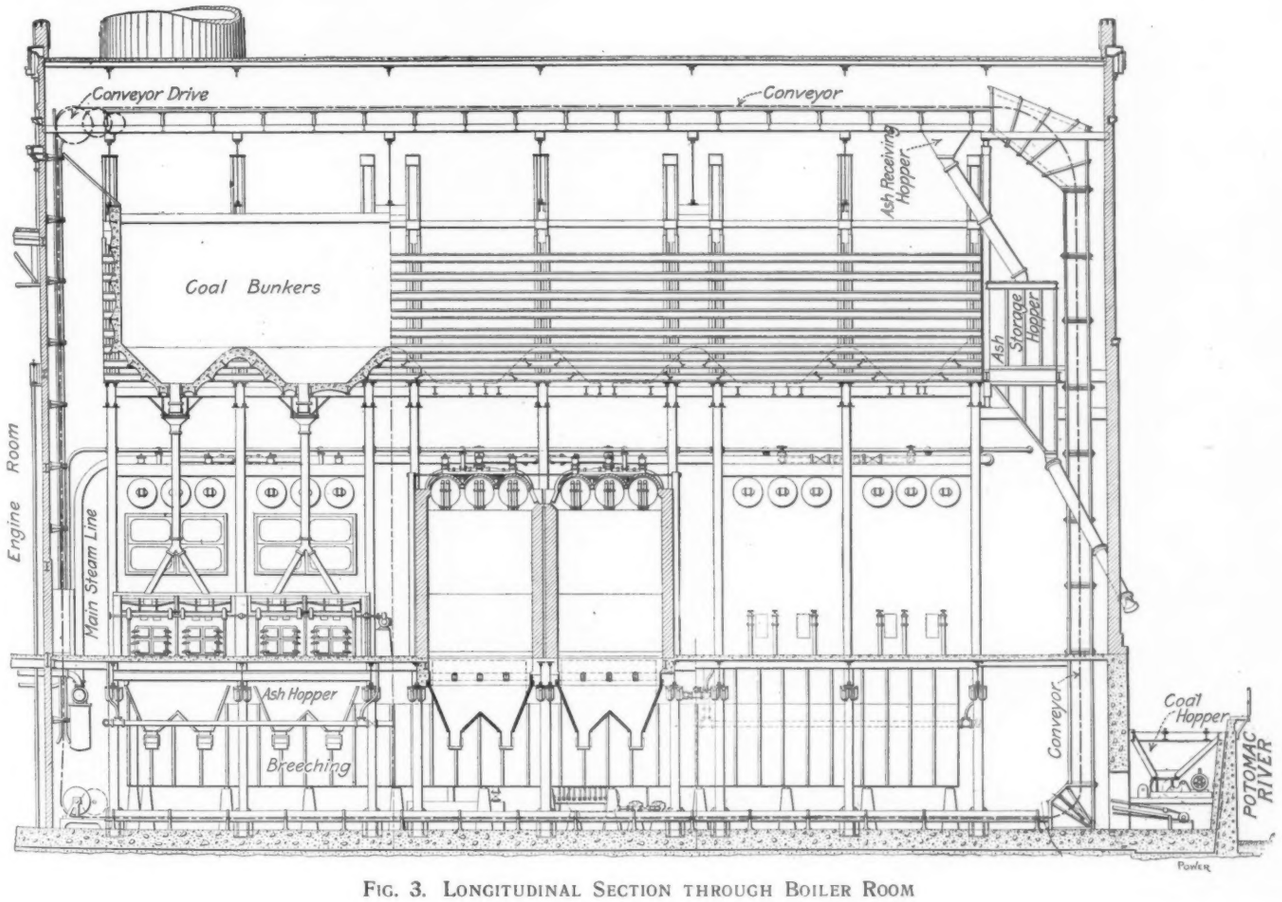


Fig. 3. Longitudinal Section through Boiler Room

Feed-water System

The water supply, both for the condensers and the feed water, is brought into the plant in a reinforced-concrete rectangular tunnel extending through the river wall at the up-stream end of the building and passing through the full length of the engine-room basement. A similar reinforced-concrete tunnel takes

the discharge water from the condensers, running under the full length of the basement and discharging through the river wall at the down-stream end. A well for feed water situated under this basement floor is connected by a 12-in. pipe with both the discharge and intake tunnels. From this well water is taken by two 6-in. vertical submerged centrifugal pumps, each having a capacity of 600 gal. per minute and operated by a 40-hp. induction motor, and is delivered to two large tanks situated on the pump-room roof.

From the tanks, the water flows by gravity either directly or through a battery of Loomis-Manning sand filters, to two Cochrane feed-water heaters, and from these it goes to the boiler-feed pumps.

Coal and Ash Handling

Coal is unloaded from the cars directly into a hopper outside the building on the river wall. Immediately below the hopper is a crusher which reduces all the coal to stoker size. From this it is delivered by a belt conveyor to the main conveyor which is of the endless type, elevating the coal to the bunkers and also carrying the ashes from the ash hoppers under the boilers to a storage bin from which they are discharged by chutes to the cars. The coal bunkers have steel frames, with concrete arches and a total capacity of 1800 tons. They are so constructed that they will completely empty themselves without any trimming of the coal by hand.

Turbine Room

The turbine room is 154 ft. long by 65 ft. high and is finished in green enamel brick for 7 ft. above the floor and has red pressed brick above this. The floor is of "Kompolite," an asbestos preparation of dark red color, furnishing a very pleasing contrast with the finish of the room. The switchboard galleries are of concrete construction and are located on the north side of the room.

At the present time four Westinghouse horizontal turbines are installed. Two of these are 1500-kw. machines, the third has a capacity of 3000 kw., and the fourth 5000 kw. The first three of these machines were moved from the Grace St. station while the largest machine is new. The two smaller machines are served by Wheeler surface condensers and Edwards air pumps; the 3000-kw. machine by an Alberger jet condenser, with the circulating pump driven by a Fleming-Harrisburg engine, and the 5000-kw. machine is equipped with a LeBlanc condenser. The first three turbines are all single-flow machines and the new machine is of the double-flow type.

The writer recently examined the blades of one of the 1500-kw. machines and found very few signs of erosion, and as none of the blades had been renewed during the four years of almost constant use of the machine, this speaks very well for the cost of upkeep for this class of turbine. The machines all operate at 1500 r.p.m. and generate 25-cycle currents at 6600 volts.

There is room in the building as it now stands for another unit of 5000-kw. capacity. Moreover, the company has enough ground on the east of the plant to extend it until the capacity will be at least 30,000 kw.

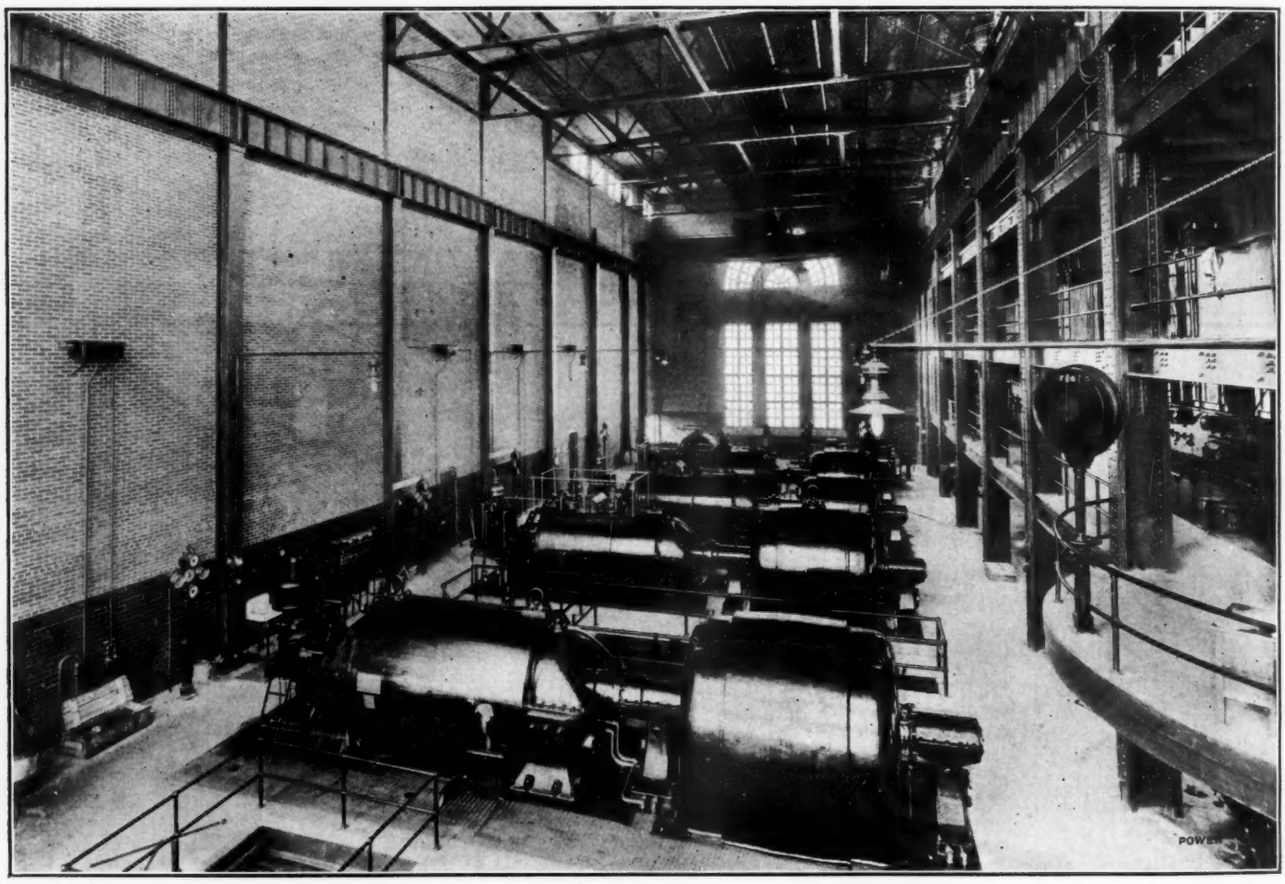


Fig. 4. Turbine Room and Switch Galleries

Auxiliary Apparatus

There are several features of interest in the auxiliary apparatus. In the first place, it was considered more economical to operate these on saturated steam, as the cost of upkeep on the units themselves would be much less than when operating on superheated steam, although the economy is a little less with saturated steam. This is practically balanced, however, because these units exhaust into the feed-water heaters and much of the heat is recovered. The arc lights for

the power house and the lights for the barn and offices of the company are supplied by one 150-kw. and two 75-kw. generators driven by Fleming-Harrisburg tandem-compound engines. There is also a 65-cell, 160-ampere, 8-hr. storage battery floating on the line for emergencies.

SWITCHBOARDS

The switchboards are arranged in a three-story tier of concrete galleries on the north side of the turbine room, as shown in Fig. 4. The switchboards are laid out with three main divisions, two of which are now installed, the third being for extensions of the plant. Particular attention has been paid to making everything as nearly trouble-proof as possible.

The design and erection of the plant have been under the direction of John H. Hanna, chief engineer of the Capital Traction Co., and the operating engineer in charge of the plant is C. J. Hoshall.

Use of Oil in Steam Lines

BY C. F. HOLLEY

The use of oil in headers and steam lines does not appear to be as general as it should be. It is in quite general use on a Michigan mining range where steam lines from 3 to 6 in. in diameter are quite common and one line is 3000 ft. long.

These lines supply steam to the pumps and means must be provided to avoid small leaks. The lines are put in as well as possible and expansion joints are used at intervals, but in spite of all precautions leaks will appear. It would entail considerable trouble and expense to make new joints at such places.

The remedy adopted is to place a lubricator in the boiler house to feed oil into the line. On the start about a quart of oil is daily fed into the line until the leaks have taken up, which does not take over three or four days as a rule, after which the amount is reduced and does not usually exceed one quart per week.

The oil works into the small leaks and cakes there; it also lubricates the expansion joints and prevents erosion of the pipes. Naturally it tends to clog the traps, but it is much easier to clean the traps than to repair the lines in any other way that I know of.

It will surprise one who has not tried it to see how large a leak can be stopped in this way. I have seen a leak in a screwed joint in a line carrying 125 lb. steam pressure, that could be heard at a distance of 200 ft., stopped in this way within 48 hours, and it did not start up again.

I would advise anyone having such trouble on headers or steam lines to try the oil treatment; it can do no harm and it will be found that it will save much annoyance and work.

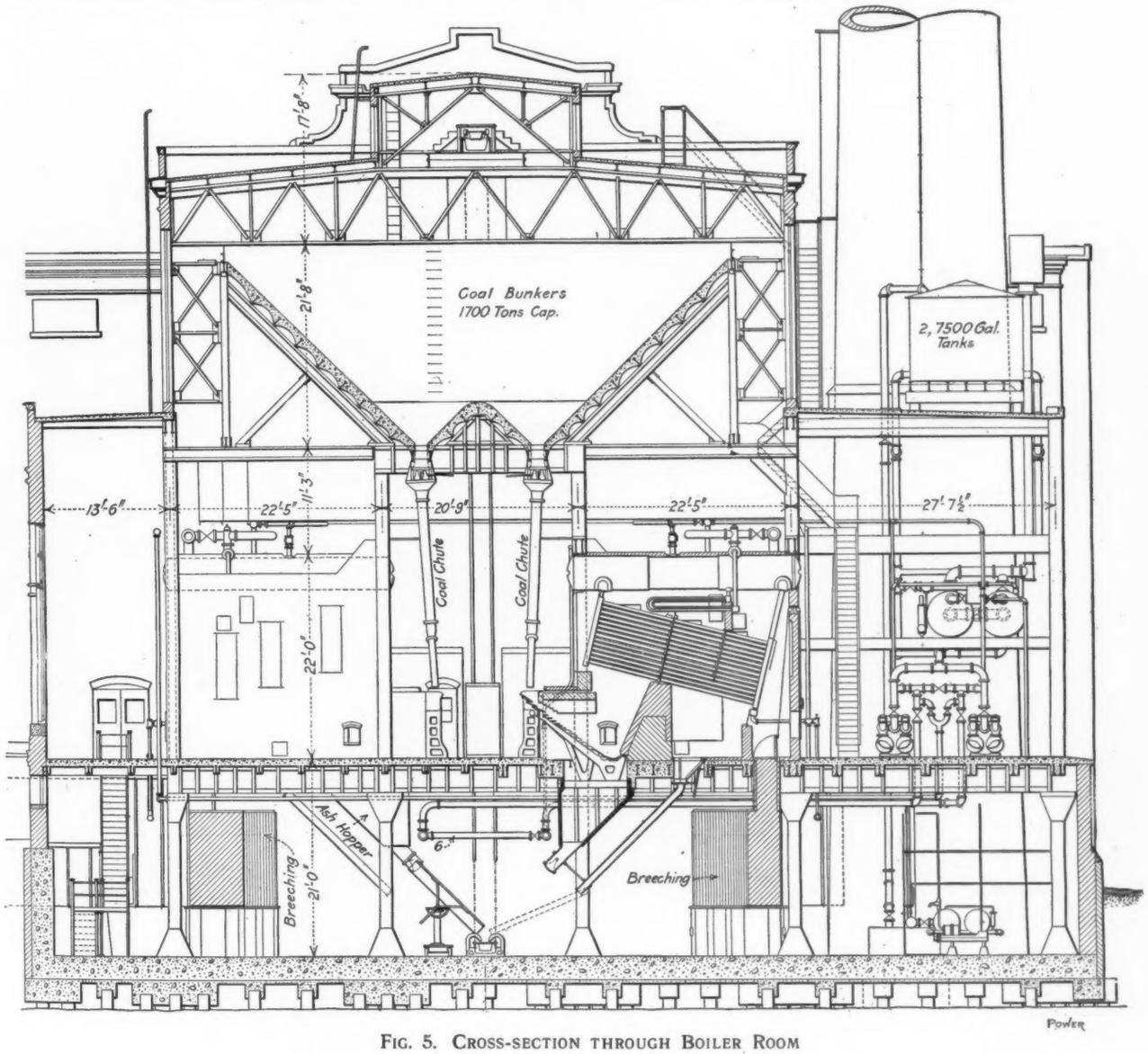


FIG. 5. CROSS-SECTION THROUGH BOILER ROOM

James Watt in Cornwall in 1781

By Prof. W. D. Ennis

Facsimile of a letter written by Watt in 1781 to John Hall concerning a contract for an engine and boiler. Brief historical sketch of Watt's work and achievements prior to and during the year 1781.

At about the time of the battle of Bunker Hill, there were hard times in Cornwall; the mines were flooded and the old Newcomen engines could not keep them pumped out.

Fortunately, the young Scotch apprentice, Watt—who had drifted back to Glasgow from London, and, after some difficulties with local labor leaders had been employed in the university—had not only conceived his steam engine, but had formed his life-long partnership with Boulton. The latter was a fine, generous, optimistic, healthy sort of man, industrious, a good manager, a successful engineer and an ideal partner to pull in double harness with Watt. The two built a small plant at Birmingham and began to sell the James Watt steam engines.

For some years Watt lived the intensely active life of an erecting engineer, principally in the mining districts, where the engines were sold on a royalty basis, the builders being paid one-third the value of the fuel saved by the substitution of the new machines for Newcomen engines.

The partners alternated in their residence in the south of England. After considering the building of a portable house, Boulton finally purchased, near Pendennis castle, in the Turnnap valley, not far from Truro, an old-fashioned roomy house and garden called Cosgarne. Here the Watt and Boulton families resided in turn for several years. Fourteen of their engines were within easy reach by horseback; some of them were in sight.

In the year 1781, the Cornwall battle was nearly won, and the mines were saved. Two years later the last of the Newcomen engines was ousted, and Watt considered his next step.

The Polytechnic Institute of Brooklyn has in its possession a letter (presented by J. D. Steele, Esq., Sept. 29, 1869) written by Watt, dated at Cosgarne, Oct. 16, 1781, in which he speaks vividly (if unintentionally) of the condition of things with him at this period. The letter is a discovery, as it does not appear in any of the biographies of either Boulton or Watt.

FIG. 1. FRONT SIDE OF THE WATT AUTOGRAPH

The inventor has already built a blowing engine for some firm, the name of which is illegible. The Snow Hill (near Birmingham) and Wilkinson engines, the latter at Bradley, are the only ones of this type of prior date mentioned in the biographies. Watt has now an order from Samuel Walthers & Co., of Roth-

eram ("Walker's ironworks at Rotherham," according to one historian). The builder writes a minute letter of instructions to the local engineer for Messrs. Walthers. He realizes the epoch-making importance of the new application, but understands also that the Walthers firm is interested only in getting their necessary blast.

He is a very busy man. He reached Cosgarne on the first of June. All summer he has been nursing his engines, standing in mine pits, perhaps, throughout the day, keeping up his voluminous correspondence and perfecting his rotatory-movement inventions by night. A confirmed dyspeptic, and in chronic ill health, the climate tires him. He writes: "There is no going out without getting wet to the skin. When it rains in Cornwall, and it rains often, it rains *solid*." He is short of help and appeals to Boulton, "I wish you could find me out a draftsman. I cannot stand it much longer." Again he complains, "my head aches." He speaks of "backache, headache and lowness of spirit"; says he is "stupid and ill and scarcely able to think." He is worried about the Hornblower infringements. Someone has told him of a boiler which evaporizes a hogshead of water from an ounce of coal. His engine building has not begun to pay—it did not, in fact, until 1785—and money matters are distressing him.

Now he has had to rob a little time to make a drawing for Mr. Hall by candlelight. He apoligizes for its inaccuracy, but has guarded against errors in the proper way. He has taken the radical step of greatly increasing the size of boiler, while at the same time adapting it to the location in which it must be installed. He does not seem to mind making the fireman stand outdoors. The most important point in the letter is the statement regarding proposed control of the *vis inertia* of the "belly" piston. It was in this same month—on Oct. 25, just nine days later, in fact—that he took out his patents on the "sun and planet" wheels and on three other devices for transforming reciprocating to rotatory motion. The method now used (with connecting-rod and crank) had already been patented by someone else.

The letter, facsimiles of which are reproduced herewith, gives an intimate picture of the busy, harassed man, 45 years old, winning fame and forgetting his ill health in the hardest kind of work. He has not finished his work; he has not yet made his engine double acting, nor introduced the indicator and the centrifugal governor. Nor has he set himself down (as he did in later years, after he became a Doctor of Laws of Glasgow University) as the opponent of high pressure, compounding, and the railway locomotive. He is the middle-aged man at the best of his powers who has success in sight. A *verbatim* copy of the letter follows:

[Postmark **Truro**]

only double letter

Mr. John Hall, Engineer
at Messrs Samuel Walthers & Comp'y:
Rotheram

via Bristol Yorkshire

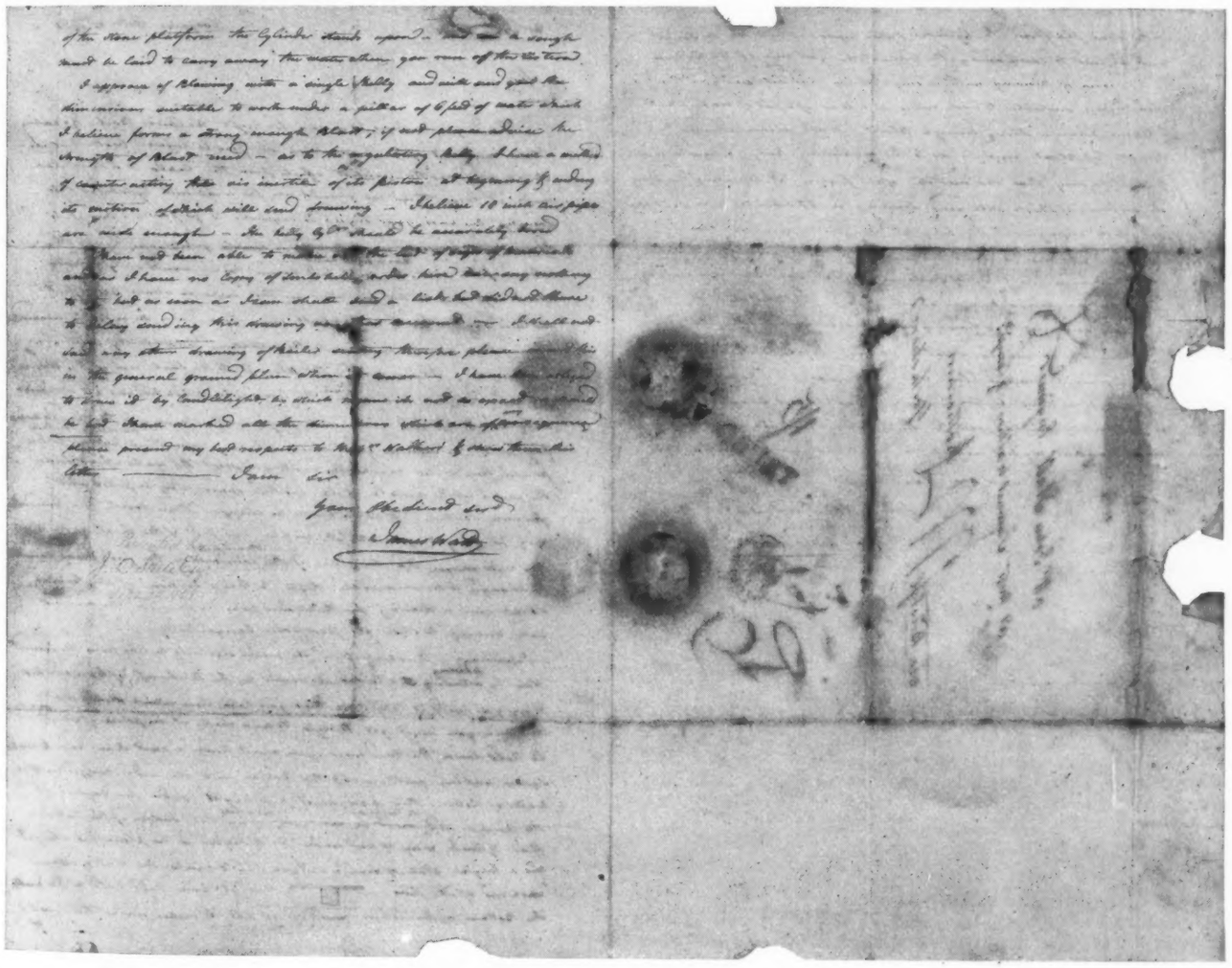


FIG. 2. REVERSE SIDE OF THE WATT AUTOGRAPH

Cosgarne, Octo 16th 1781

Mr John Hall

Sir—

I send you inclosed Drawing for Messrs Walthers Boiler and seating. I have made it of the form which we find to answer best, that is which produces the greatest effects from the coals—I have also made it larger than we should use for a 40 inch Cylinder in this county, because your Engine is required to

go faster—One of its advantages consists in a much greater surface to the action of the fire, than a round boiler for a 12 feet round boiler would only expose about 170 feet to the fire whereas this exposes above 300 feet and will require only a few cwts more Iron—In order to accomodate it as much as can be done to the situation consistently with convenience, I have moved it almost to the back-end of the House and made the fire door behind the house by which means it occupies only about 12 feet wide sideways—You may get the foundations dug for it as soon as you will, and may leave therin the walls hollow within to the prickit line which marks the seating except the walls which form the sides of the ashole.[1] The middle space may be filled with furnace cinders—If stone work be cheaper than brick the foundation may be brought up with it within one foot of the level of the Grate You will observe that the place of the steam pipe windows in the first floor must be changed to accomodate them to this situation of the Boiler. I shall send a drawing for the steam pipe afterwards the present only serving to show its position horizontally.

I approve of a Brick cistern its inside size may be had from the ground plan by deducting allowing 3 inches all round for the thickness of the wood but before you build it take care that you have lime which stands water otherwise you must get terrass[2] to mix with it in place of sand To hold down the condenser you must have a cast Iron barr 6 inches square passing quite across the Bottom with its ends lodged in the walls of cistern this Barr must pass right under the centers of the pumps and its lower side must be one inch and a half above the bottom of the cistern that Glands may be put under it & shifted to the place we chuse and a longish plate of iron must be built into the Walls above each end of it thus [see sketch near foot of first page of autograph] that it have good hold of the walls The Bottom of the Cistern must be 10 feet 6 inches under the level of the stone platform the Cylinder stands upon—and a sough must be laid to carry away the water when you run off the cistern.

I approve of Blowing with a single Belly[3] and will send you the dimensions suitable to work under a pillar of 6 feet of water which I believe forms a strong enough Blast, if not please advise the strength of Blast used—as to the regulating Belly I have a method of counteracting the vis inertia of its piston at beginning & ending its motion of which will send drawing—I believe 18 inch air pipes are wide enough—The belly cyl'rs should be accurately bored.

I have not been able to make out the list of sizes of materials and as I have no copy of[4] order here can say nothing to it but as soon as I can shall send a list but did not chuse to delay sending this drawing on that account—I shall not send any other drawing of Boiler seating therefore please insert this in the general ground plan when it comes—I have been obliged to draw it by candlelight, by which means it's not so exact as should be but I have marked all the dimensions which are of any consequence—please present my best respects to Messrs Walthers & show them this letter———I am sir

Your Obedient ser't
James Watt

[1]Ashpit.

[2]Terrass, or Dutch trass, a soft rock, burnt and ground.

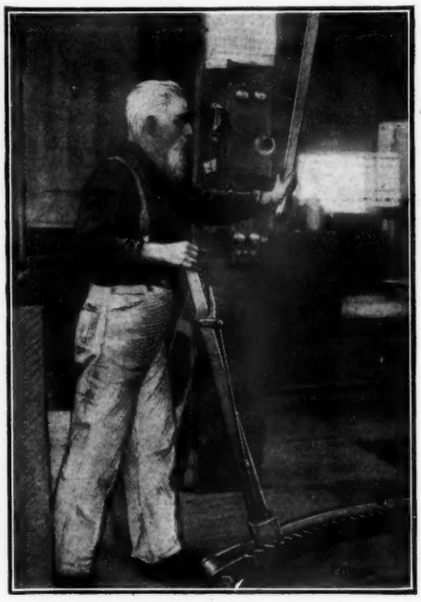
[3]Obviously a blowing cylinder or tub. An old singular form of the word bellows.

[4]Name of a firm to whom the writer had previously sold a blowing engine.

Samuel Reynolds

The adage, "Once an engineer always an engineer," may aptly be applied to Samuel Reynolds, who for 42 years has been employed by the Lehigh & Wilkes-Barre Coal Co., at the Nottingham Colliery, Plymouth, Penn.

Mr. Reynolds was born in the mining region of Michigan 67 years ago and would feel uncomfortable away from the atmosphere surrounding the mine. For 30 years he has operated the same engine, which is used for slope work in the Nottingham mine, and during his career as a hoisting engineer he has never experienced a serious accident, which speaks well for his ability, quick eye and alertness of mind.



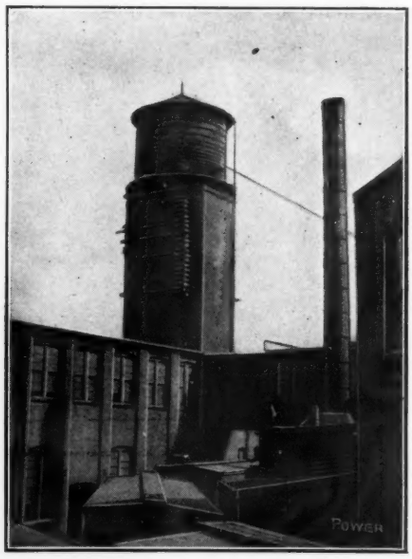
SAMUEL REYNOLDS, FOR FORTY-TWO YEARS A HOISTING ENGINEER

The illustration shows Mr. Reynolds at his familiar throttle and reversing lever. So accustomed has he become to the varying load on the engine that he can form a practically correct estimate of the load he is handling, although the work is hundreds of feet below the surface. He laughs at the thought that a man has passed his days of usefulness when he has reached the age of 50, and he expects to operate his engine for years to come.

Raising a Water Tank

BY A. E. DIXON

Occasionally it becomes necessary to raise a water tank. The accompanying photograph shows how a concern in Cleveland, Ohio, solved a problem of this kind. Holes were cut in the sides of the brick tower supporting the tank so that needle beams could be inserted at a sufficient distance below the tank platform to give room for the four jackscrews used in lifting. These beams also served to support the interior scaffold upon which the bricklayers worked and the cribbing required to support the tank after a lift had been made.



TANK IN PROCESS OF RAISING

The tank rested upon a platform of steel beams. A heavy timber was placed below this and secured to the steel framing, one on each side of the square tower. These served to distribute the thrust of the jackscrews, two on each side of the tower, resting upon cribbing supported by the needle beams. The four jackscrews were operated simultaneously by four men who turned the screws a part of a revolution on a given signal. As soon as a lift was made, cribbing inside of the tower was built up to the tank platform. The jackscrews were then run down and made ready for another lift. When a sufficient height had been gained the bricklayers were set to work and the brickwork was carried up under the tank.

The illustration shows the completed work and the cribbing on one side of the tower supporting the jackscrews. Stringers between the two piles of cribbing served as a working scaffold for the men operating the screws. At the time the picture was taken the jacks were still in place, but they are hidden by the dense shadow under the tank.

Various Types of Steam Meters

By Prof. G. F. Gebhardt

Description of those steam meters in which the steam is throttled and the pressure drop utilized to indicate the flow. In the Feb. 6 issue those meters depending in principle upon the velocity of the steam were considered.

In the group of meters described in the Feb. 6 issue, the indicating and recording mechanism is actuated by the natural velocity of the steam. In the group about to be described the velocity is increased a small amount by throttling and the pressure drop is utilized in actuating the recording mechanism. They may be conveniently classified according to the manner in which the throttling is effected as (1) "floating valve," (2) "stationary disk" and (3) "venturi tube." The weight of steam flowing through the orifice may be calculated from the following modification of equations (1) and (2). (See Feb. 6 issue.)

$$W = AK\sqrt{p_1 - p_2} \qquad (5)$$

in which

W = Pounds discharged per second;
A = Area of the orifice;

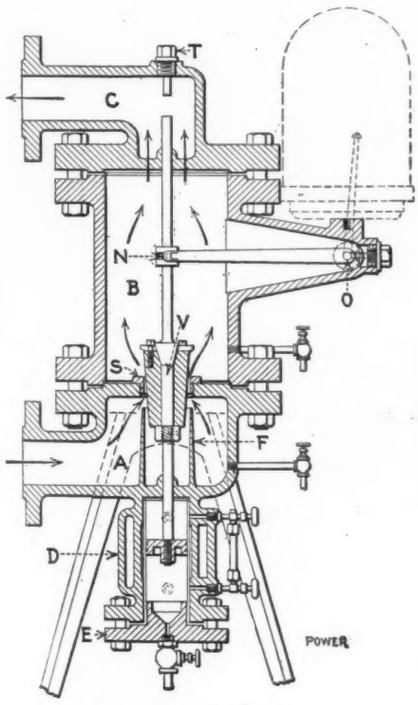


FIG. 1. ST. JOHNS METER

K = Coefficient determined by experiment and includes the density of the steam;
p_1 = Pressure on the inner side of the orifice, in pounds per square inch;
p_2 = Pressure on the discharge side of the orifice, in pounds per square inch.

In some of the meters the pressure drop, $p_1 - p_2$, is maintained constant and the variation in the area A actuates the indicating mechanism, and in others the area is made constant and the variation in pressure drop operates the mechanism.

ST. JOHNS STEAM METER

Fig. 1 represents a section through a St. Johns steam meter, illustrating the throttling type with a floating valve. This meter was placed on the market 20 years ago and still finds favor with many engineers. It records the weight of steam passing through the seat of an automatically lifting valve which rises and falls as the demand for steam increases or diminishes.

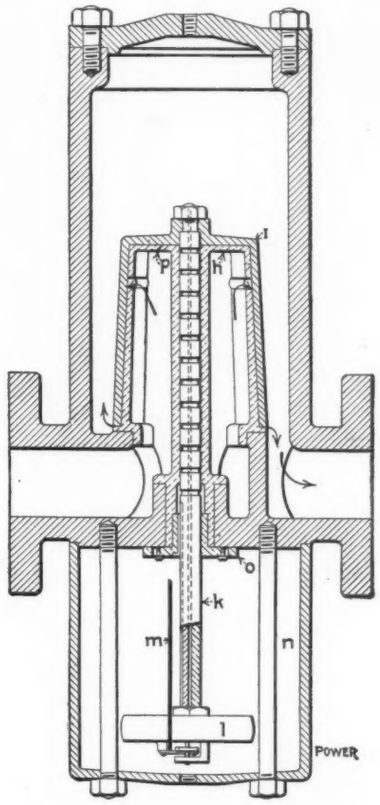


FIG. 2. SARGENT INDICATING METER

Referring to the illustration, valve V is weighted so that a pressure in space A of 2 lb. greater than that in B is necessary to raise the valve off its seat. This pressure difference is constant for all positions of the valve. The plug is tapered so that the rise of the steam pressure is directly proportional to the volume of steam flowing through the seat. The movement of the valve is transmitted through suitable levers to an indicating dial and a recording pen so that the instantaneous and continuous rate of flow may be read at a glance. For a given pressure and quality of steam, the indicating dial and chart may be calibrated to read the weight of discharge directly, corrections being made for variations in pressure and quality. The manufacturers guarantee the readings of the chart to be within 2 per cent. of condenser measurements for a total pressure range of 10 lb. from the mean pressure at which the chart is calibrated.

The chief drawback to this instrument is inherent to all meters of the series type in that they are bulky and the steam line must be taken down for the installation. The total hourly flow may be obtained by integrating the curve. Tests of this meter made by the writer were in accord with the guarantee of the manufacturer for continuous flow and for moderate changes in the rate of flow. For rapid fluctuations in flow the results were not so satisfactory, the greater error lying in the difficulty of integrating the curve correctly.

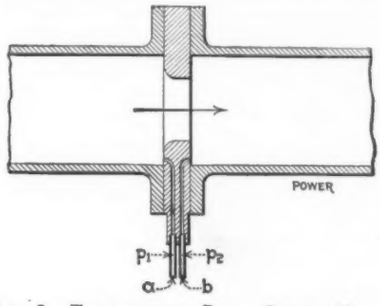


FIG. 3. THROTTLING DISK GEHRE-HALLWACHS METER

SARGENT STEAM METER (1908)

The Sargent steam meter, Fig. 2, differs from the St. Johns meter in that a variation in pressure is automatically compensated for. The principles of operation are the same: steam enters on the left and passes up around the valve stem, and as the pressure increases, flows through the opening p, raising the valve i from its seat and allowing the steam to pass down between the inside and outside cones to the discharge side of the meter as indicated by the arrows. The valve stem k is open to the atmosphere and its exposed area determines the pressure difference necessary to raise the valve from its seat.

Since this pressure difference (about 2 per cent. of the initial pressure) is constant, the lift of the valve will be a direct measure of the amount of steam flowing through the seat. This vertical movement of the valve is transferred by

the indicating needle *m* to a suitably calibrated chart. Pressure correction is automatically effected as follows: A bourdon tube *l* is fastened to the end of the valve stem and rises and falls with the movement of the valve. The valve stem *k* is hollow and connects the bourdon tube with the steam space above

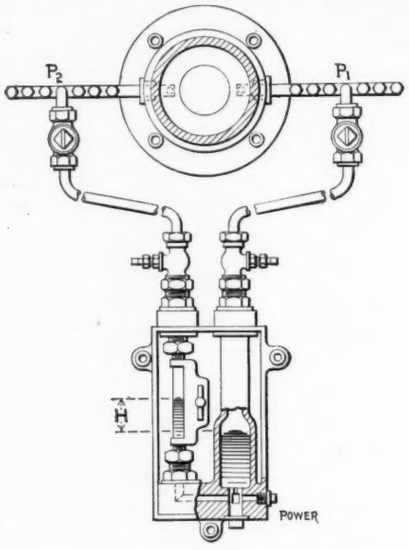


FIG. 4. INDICATING MECHANISM OF GEHRE-HALLWACHS

the valve *i*. Variation in pressure above the valve causes the tube to swing the indicating needle *m* to the right or left, as the pressure increases or decreases. The readings of the chart as indicated by the needle are consequently automatically corrected for pressure variation. Tests of this meter gave approximately the same results as the St. Johns. It is a purely indicating device and hourly results can be obtained only by plot-

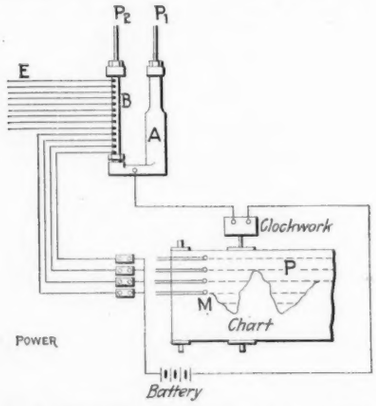


FIG. 5. DIAGRAM OF ELECTRICALLY OPERATED RECORDER

ting the readings at frequent intervals and integrating the curve drawn through them.

GEHRE-HALLWACHS STEAM METERS

The Gehre-Hallwachs steam meters, the results of 20 years of experimenting by Max Gehre, are the most popular in Germany and are being rapidly adopted in England and to a limited extent in America. They are made in a number of styles, indicating, recording and integrating, and cover a wide range of practice. The meter consists of two elements, a throttle disk, Fig. 3, which is permanently inserted in the pipe line at the point where the rate of flow is to be measured and the indicating or recording mechanism (Figs. 4 to 6), which may be placed anywhere below the disk and at any distance from it. One indicating mechanism or one recorder may suffice for a number of disks, provided, of course, continuous records are not desired from each.

Referring to Fig. 3, variation in the rate of discharge through the orifice which is of constant diameter will cause the pressure difference, $p_1 - p_2$, to vary, the maximum pressure difference being less than 1 lb. per square inch. Pressures p_1 and p_2 are transmitted to the indicator or recorder through the small tubes *a* and *b*. The general details of the indicating mechanism are shown in Fig. 4; which is a simple mercury manometer. For general purposes, the apparatus is fitted with a revolving chart calibrated for different pressures and qualities of steam. Great care must be taken in adjusting the chart for the required pressure, pipe diameter and quality of steam, all leaks must be eliminated from the piping and the entire system must be freed from air pockets. These precautions apply equally well to all meters involving the use of mercury manometers.

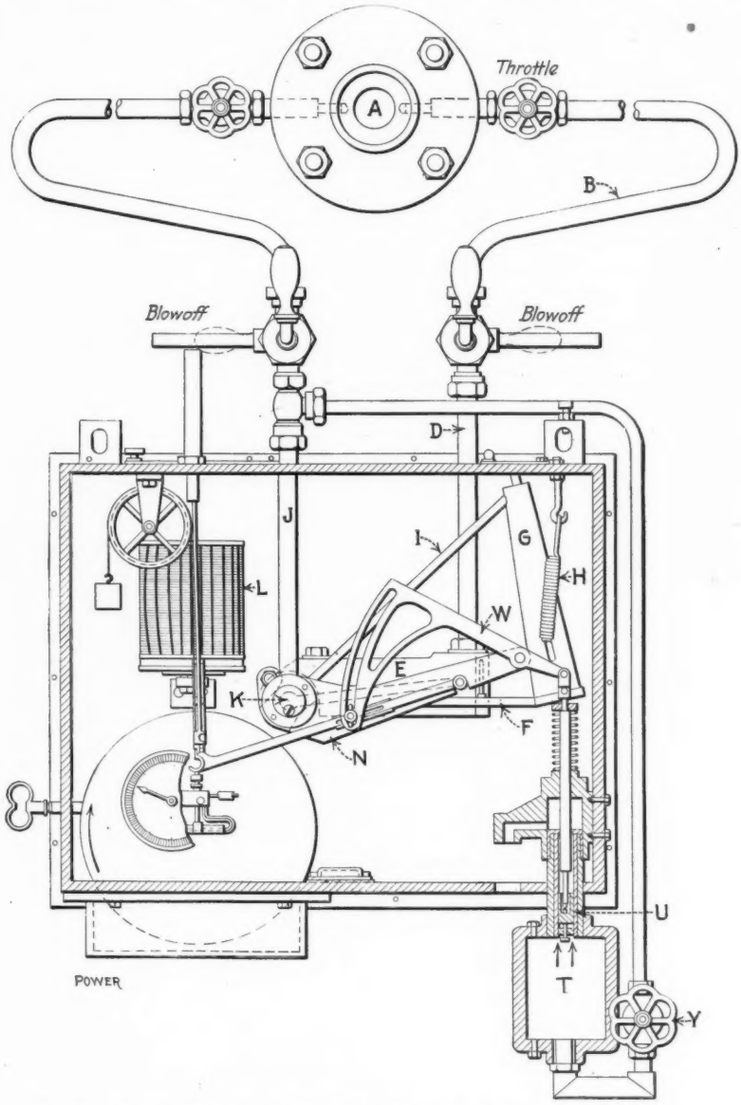


FIG. 6. SARCO AUTOGRAPHIC INDICATING AND INTEGRATING METER

Two styles of recorders are manufactured for this meter, one electrically and the other mechanically operated. The principles of the earlier form of electrically actuated recorder are shown in Fig. 5. A number of electrical terminals *E* are inserted in column *B* of the mercury manometer. As the mercury rises it closes a corresponding number of circuits which in turn actuate magnets *M*. These magnets perforate at regular intervals a clock-driven chart *P*. The contour formed by the perforation records the

height of the mercury column and hence is a measure of the weight of steam flowing through the throttle disk. The accuracy of the perforated record is necessarily dependent upon the spacing of the electrical terminals. No automatic compensation is made for pressure variation or change in quality.

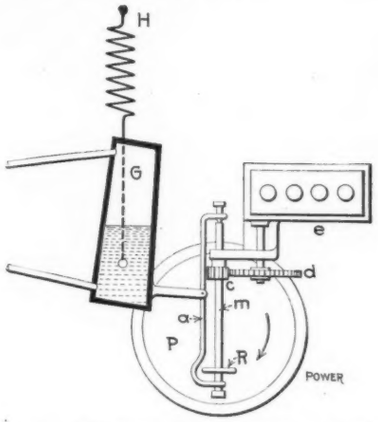


FIG. 7. SHOWING PRINCIPLES OF SARCO METER

In the later type of electrically operated recorder, the different circuits actuate a solenoid, the core of which is fastened to the recording pin. Automatic compensation for pressure variation is effected by a bourdon tube which varies a resistance. By connecting the different circuits to a small motor the speed of the latter may be varied according to the height of the mercury column in the manometer. This forms the basis of the integrating meter.

The meter fitted with indicating, autographic and integrating devices represents the nearest approach to ideal station practice, since the instantaneous rate of flow, the rate of flow for any length of time and the total flow for a given period are always available, and the electrical control enables it to be placed at any distance from the steam pipe, thus facilitating centralization of all meters. The success of these instruments is evidenced by the fact that 7000 of them have been installed in Germany during the last two years and the German government has adopted them for official tests in its department of boiler inspection.

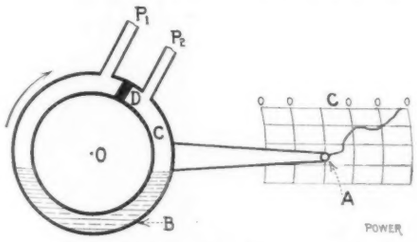


FIG. 8. SHOWING PRINCIPLES OF THE STORRER METER

The mechanically operated recorder and integrator is shown in Fig. 6, and the principles of operation are illustrated diagrammatically in Fig. 7. This instrument is manufactured in England under the name of the Sarco steam meter. Referring to Figs. 6 and 7, the high-pressure side of the throttle disk is connected through pipe *D* to reservoir *E* which is filled with mercury; this is connected by a tube *F* to a hollow cone-shaped vessel *G*. The cone *G* and its connecting tubes *F* and *I* are suspended from springs *H*, one on each side of the cone, and are free to move about the trunnion *K*. It is evident that the pressure difference, $p_1 - p_2$, acting through the water in *D* will force the mercury in *E* out along tube *F* into the cone *G*, causing the latter to sink. The recording pen is fastened to the cone and hence traces the movement of the latter on the clock-driven chart *L*.

This mechanism differs from the General Electric recording meter in that the motion of the pen is directly proportional to the weight of steam flowing and hence the chart may be integrated with an ordinary planimeter. This is brought about in a very ingenious way. The height of the mercury in *G* varies approximately as the square of the weight of steam flowing through the throttle disk, so that the weight of mercury in *G* (and consequently the movement of the pen) would vary correspondingly if the vessel were cylindrical. By tapering *G* so that the weight of mercury increases approximately as the square root of the height, the pen movement is made to vary directly with the flow of steam.

This uniform motion of the pen makes it not only possible but comparatively easy to add an integrating mechanism. Referring to the detail, Fig. 7, *R* is a small friction wheel mounted on the pen arm *a* and connected to gears *c* and *d* by the small shaft *m*; *P* is a clock-driven disk in contact with the friction wheel *R*.

As the pen arm moves the wheel *R* in and out from the center of disk *P*, the speed of the small friction wheel is decreased or increased accordingly. The revolutions of *R* are transmitted to the integrating mechanism *e* so that the total flow may be read directly from the dials. Variation in pressure is compensated for by the spring-resisted piston *U*, Fig. 6, which increases or decreases the displacement of the pen.

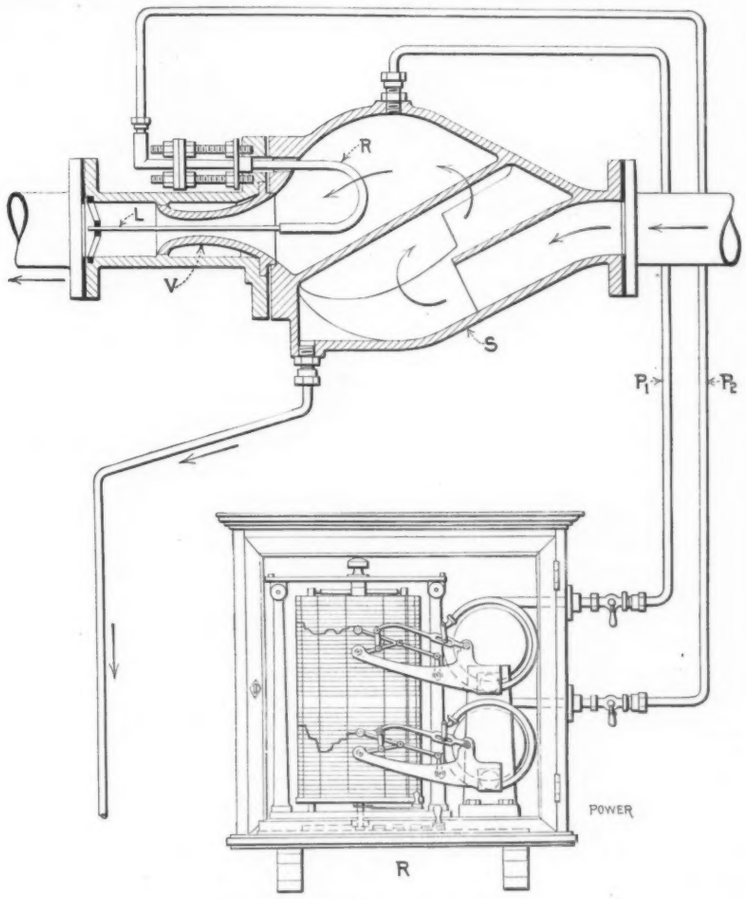


FIG. 9. ECKARDT STEAM METER

STORRER STEAM METER

A novel manometer for recording small pressure changes is used by Storrer in his autographic indicating steam meter. The principles of operation are shown diagrammatically in Fig. 8, in which *B* is a hollow torus-shaped vessel, partially filled with mercury and free to rotate

about the axis *O*. Diaphragm *D* divides the upper portion into two parts. The opening P_1 is connected to the high-pressure side of a throttling disk and the opening P_2 to the low-pressure side of the meter.

The pressure difference tends to force the mercury up into chamber *C*; this increases the leverage on the right and causes the vessel and the attached recording arm to rotate clockwise until equilibrium is established. The deflection of point *A* is a measure of the pressure difference and consequently of the weight of steam discharged. Correction for pressure variation is automatically effected by a small steam piston which changes the position of the pen-arm pivot relative to the axis of the torus. The apparatus is compact, portable and easily applied, but it is not as sensitive as other meters of the mercury manometer type on account of the great inertia of the torus and the friction of the trunnions.

Eckardt's Steam Meter

The venturi tube has been used as a steam meter in Europe for a number of years and is finding some favor in this country. A section through the Eckardt recording steam meter is shown in Fig. 9. It consists essentially of a steam separator *S*, a venturi meter *V* and a pressure recorder *R*. The pressure at the throat is transmitted by pipes *L* and P_2 to a clock-driven recorder and the pressure at the entrance is transmitted by pipe P_1 to a similar recorder. The difference in pressure is a measure of the weight discharged and may be easily calculated. Tests of the meter proper have given consistent results, but the use of two pressure charts is awkward and unsatisfactory. No automatic correction is made for pressure variation.

The Builder's Iron Foundry have adapted their venturi meter to the measurement of steam with some success. The writer found the meter proper to agree within 3 per cent. of the condenser readings for continuous flow and for constant initial pressure and quality, but he did not have the opportunity to test out the recording apparatus.

Perenty Steam Meter

The latest form of Perenty steam meter is perhaps the most convenient application of the venturi tube to the measurement of steam. The pressure difference actuates a tilting column similar in principle to that of the General Electric recorder and the automatic pressure correction is made in a similar manner to that illustrated in Fig. 6.

The chief objection to the venturi type is that the piping must be disconnected when installing the meter.

In conclusion, it may be said that the average high-grade steam meter is a reliable and accurate means of measuring the flow of steam in straight lengths of pipes provided the flow is continuous, or that the change in the rate of flow is gradual and the pressure and quality are practically constant. For interrupted or intermittent flow and for sudden variation in pressure or quality, the results are not reliable and may be considerably in error. The accuracy of all meters, provided they have been correctly calibrated and adjusted, depends largely upon the degree of refinement in reading the indicators and in integrating the charts. The commercial failure of many steam meters is due to the fact that they are not cared for or operated in strict accordance with the principles of design.

Progress in British Marine Engineering

Marine engineering in Great Britain has been making steady progress, says the Glasgow *Herald* in its review of the year's work. The reciprocating engine continues to hold its own, and is bigger, more economical, and its cost is less.

The most striking tendency of progress has been to take the auxiliaries off the main engines and drive them independently.

Making of Turbines

More marine turbines of the Parsons type were made in 1911 than in any preceding year, the Parsons Co. reporting that, up to June 30, about 6,400,000 hp. had been made, of which 1,900,000 hp. belonged to 1910-11. At the commencement of the last half of this period machinery of 2,740,000 hp. for 167 British and Colonial warships was under construction.

The effect of this naval forcing has indirectly helped mercantile shipping, and has aided in the development of the turbine to commercial requirements. The reaction type, working in series on three or four shafts, has proved so successful for high-speed merchant ships that only in detail does it seem to be susceptible to improvement.

Merchant Marine

A combination in which reciprocating engines exhaust into low-pressure turbines finds particular favor for ships of intermediate speeds similar to the "Titanic" type.

The success of the transmission system, which was installed experimentally on the steamer "Vespasian," has been unmistakable and its tardy adoption is only explained on the score of high first cost.

Turbines geared in this way are economical for slow speeds and the transmissions are efficient and reliable. After 32,000 miles of work in the North Sea, in all kinds of weather, the "Vespasian's" pinions and gear wheel showed no appreciable signs of wear, neither gear nor turbine giving the slightest trouble. No other transmission system has been tried on the Continental side of the Atlantic on the scale of an ocean-going vessel.

But little information is available of the Brown-Curtis turbines because this type is exclusively used in protected cruisers and destroyers in Great Britain, but it is finding favor in the Italian navy.

Improved Auxiliaries

The value of improved engine-room auxiliaries in the development of the turbine is probably higher than in the reciprocating engine, because with a vacuum guaranteed by the maker of the condenser the design of the turbine is simplified. Weir's uniflux condenser and dual air pump, says the *Herald*, have not only achieved wonders in this direction, but they have enabled the turbine makers to do so. They have been adopted by Great Britain, Argentina, China, Chile, Italy, Russia, the United States, Austria, France, Brazil, Denmark, Japan, Spain and Turkey, and for high-vacuum turbine-driven merchant vessels they are practically the standard. Already they have been applied to machinery representing 4,000,000 shaft horsepower.

Minor Developments

There are worthy of note two minor developments, one relating to the use of superheated steam and the other to oil fuel. The chief objection to superheating has been an unsatisfactory superheater, but a steamer designed for reciprocating engines is to be equipped with the Schmidt superheater, which, it is understood, has given excellent results on vessels based on Continental ports.

The oil development is the association of Howden forced draft with the system of oil burning specialized so successfully by a well known British engineering firm. In 1911, installations have been made representing nearly 150,000 hp.

Oil Engines

The oil engine is still in an experimental stage, so far as ocean-going shipping is concerned, although 13 oil-engined vessels, from 4500 to 8000 gross tonnage, are being built according to Lloyd's classification, and six vessels, from 100 to 3800, to the British Corporation classification.

Vessels built to Lloyd's class have both two-stroke and four-stroke engines, one of the two-stroke being of the double-acting type. For marine work the two-stroke, single-acting type seems most suitable.

Russia's peat industry has 78 firms engaged in the production of this fuel; they put out the equivalent of 544,500 tons of hard coal in 1908.

It is stated by *Coal Age* that Russia's peat deposits are sufficient for all demands for at least 40 or 50 years.

Gas Power Department

Worth-while gas-engine and producer information treated in a way that can be of practical use

The Gas Turbine*

By Prof. J. Lange

The development of the efficient turbo-compressor first brought the gas turbine within the reach of possibility. The use of piston compressors in connection with gas turbines is inevitably futile, as the required work transfer from the turbine to the compressor shaft is impossible for the high duties in queston and with reference to economy and practical operation.

No-compression Type

Hence it was next sought to avoid the compressor entirely and the explosion turbine was produced; its thermic cycle being that of the first piston gas engine of Lenoir, with the exception that in the gas turbine expansion is continued to atmospheric pressure. The fuel-air mixture at about the pressure of the atmosphere is exploded in the explosion chamber (Fig. 1) by electrical ignition; this chamber being closed against the inlet passages by a positive check valve. The gases of explosion flow through a longer passage to the nozzle in which the static energy is converted into kinetic energy. Through the sluggish action of the gases leaving the nozzle and through the cooling of the residual gases, there occurs a partial vacuum in the explosion chamber which opens the check valve and permits the inflow of a fresh charge. Like thermal conditions obtain during the suction stroke of the piston type inasmuch as the cooling of the waste gases results, even though slightly, in an increased volumetric efficiency. De Karavodine, of Paris, has brought out such a design of turbine.

The pressure variation in the explosion chamber is shown in Fig. 2. The drop to below the atmosphere is worthy of notice; on that the compressorless explosion turbine depends. The fuel consumption was about 6.6 lb. of benzine per effective horsepower per hour; substantially higher than in the first Lenoir reciprocating gas engine. Besides the lower efficiency of the noncompressor thermal cycle, the unsatisfactory fuel utilization by this machine may be attributed to the marked contamination of the fresh charge by the residual gas, and to the unfavorable hydraulic method of impingement of the gases.† To overcome this latter disadvantage the connection of a plurality of explosion chambers was made to one nozzle with a view to a more constant gas flow (see Fig. 3). The results obtained, however, are not known.

Beyond doubt, the fuel utilization of the explosion turbine is capable of improvement, as there cling to it now all the disadvantages resulting from the intermittent method of operation. It is just that intermittent action which it is the purpose of the turbine to avoid, and it is the resultant general advantages springing from such avoidance that have helped the steam turbine to victory over the reciprocating engine, not that the turbine itself could offer any particular advantages in the utilization of the steam. In the gas engine, the avoidance of intermittent action is of extreme importance because the disadvantages of rapidly succeeding temperature and pressure changes attain a much higher measure than in a steam engine. If then nothing more be done than to replace the piston and driving parts of the reciprocating engine by the nozzle and wheel of the turbine, there will be no advantage unless there result therefrom a gain in fuel utilization. That, however, is entirely out of the question as the losses in the nozzle and in the wheel buckets are materially greater than in the driving parts of the reciprocating engine. Under such circumstances the capacity for development of the explosion turbine must be considered as excluded, for it has all of the inherent defects of the reciprocating engine without showing any advantage thereover.

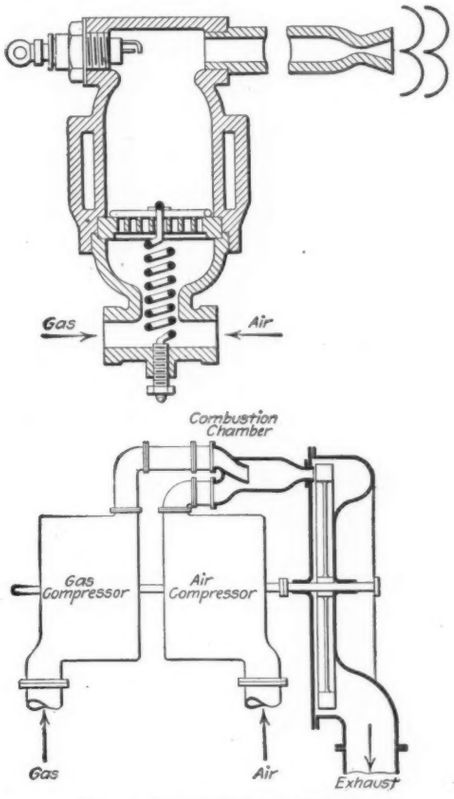


Fig. 1. Intermittent Type
Fig. 5. Contact Pressure Type

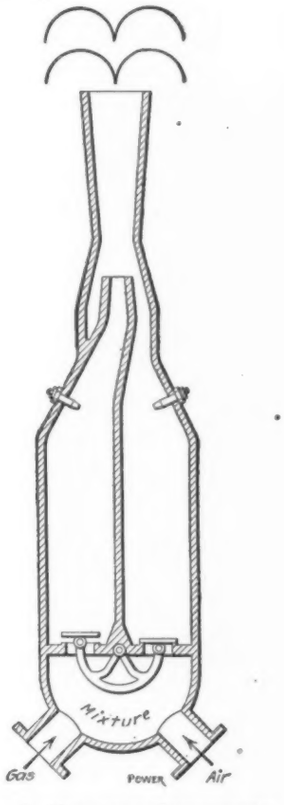


Fig. 3. Multiple Combustion Chambers

Constant Pressure Type

The operation of the constant-pressure turbine is not intermittent, and therefore it has a marked superiority over the explosion turbine. Gas and air are compressed and, after having been heated by the exhaust gases of the previous combustion, are conducted to expansion nozzles. The heating results in an increase of volume s- that the positive work of the turbine is greater than the negative work applied to compression (see Fig. 4). Fundamentally, the source of heat

*Translated for Power from an article originally published in *Stahl und Eisen*.

†The term "hydraulic" here is taken by the translator to mean jet and bucket losses in the way these would be considered in the operation of a waterwheel such as the Pelton.

increment is unimportant be it directly from the preceding combustion of the working medium or from extraneous heating of the latter. In the latter case the gas turbine becomes purely a hot air turbine. The heat transfer through combustion of the working medium is fuller and more economical, but of course this requires clean fuel, combustion without residue and such chemical condition of the gases of combustion that the material of construction of the machine will not be attacked.

The principal parts, therefore, of a constant-pressure turbine unit are the compressor, the combustion chamber and the turbine proper (see Fig. 5). For reasons of safety, the compression of gas and air must be separate. Instead of a compressor an exhauster may be used,

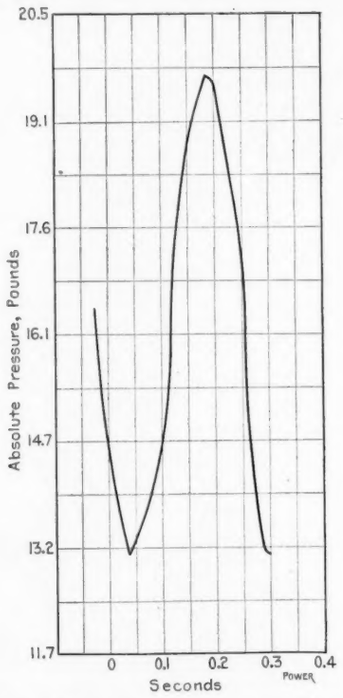


FIG. 2. PRESSURE VARIATION IN COMBUSTION CHAMBER

drawing the waste gases from the turbine housing through a cooler and expelling them at atmospheric pressure (see Fig. 6). In this case the gas and the air flow at atmospheric pressure to the combustion chamber. The gases of combustion expand in the nozzle to a pressure due to the partial vacuum created by the exhauster. It is thermally insignificant whether the cycle operates above or below atmospheric pressure when the laws governing the expansion and compression are the same and if in both cases there exist the same ratios of expansion and compression.

As between the compressor and the exhauster, practical operation must decide which is the better of the two methods of operation, or whether a combination of the two, as in Fig. 7, would be the more advisable; the turbo-compressor and the turbo-exhauster are, themselves, the deciding factors. For light loads the working limit would, more fittingly, be below the atmosphere on account of the small quantities of gas and of air and to attain greater specific volumes and at the same time sufficiently large passages. For heavy loads a higher pressure zone would be chosen in order to be able to control the gas masses.

In its capacity for control of large volumes with constructive simplicity and cheapness and for utilizing the lower areas of the diagram without materially increasing the friction load, the turbine has an adaptability not possessed by the reciprocating engine. This characteristic will have to be taken advantage of as far as possible and a substantially greater expansion ratio chosen (about 50) than is usual in the reciprocating engine. Thus it is self-evident that there must be a division of the cycle into plus and minus paths with reference to the atmospheric line, as otherwise the maximum and minimum absolute pressures could not be maintained within reasonable limits.

Along with the exhauster, as one of the main accessories of the constant-pressure turbine outfit, comes the cooler, but it would not be advisable to allow the heat abstracted from the waste gases to be lost; it is preferable to recover it. This is accomplished by making use of the compressed fresh charge as a cooling fluid to the end that the charge reaches the combustion chamber preheated, and the specific volume and work capacity of the heated gases are increased (see Fig. 4).

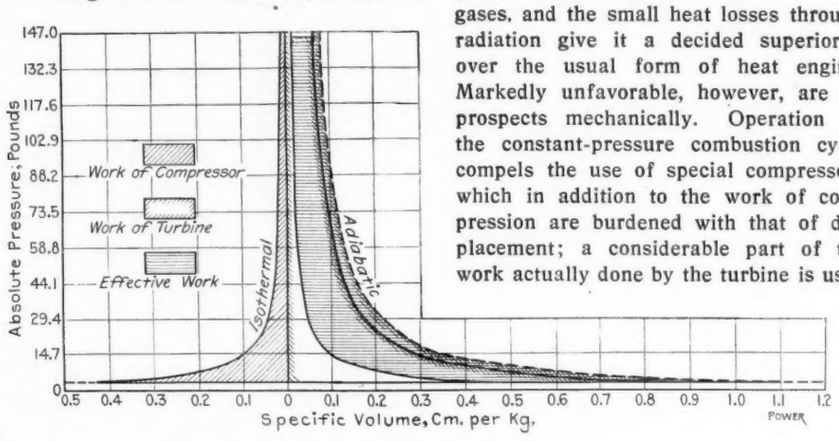


FIG. 4. CHART OF WORK DISTRIBUTION

The possibility of recovering, at least in part, the heat of the waste gases in a relatively simple manner indicates a further advantage of the gas turbine as compared with the usual heat engine, where a recovery of waste heat for utilization within the engine cycle proper is not available in practice.

An entirely new problem confronting the designer of a gas turbine is the formation of the combustion chamber. Even if, as a preliminary requirement, a recognized good type of gas burner can be used for that chief essential, perfect combustion in short space, there still remains to be overcome the difficulty in the matter of high temperature in connection with the stresses in the walls of the combustion chamber. One way of accomplishing this is shown in Fig. 8, where the compressed gas or compressed air is allowed to circulate around the actual combustion chamber, whereby its walls are relieved from pressure and hence in the matter of material therefor there remains to be considered only its fire-resistance without reference to its strength. In addition this design of combustion chamber offers the further thermal advantage that heat loss through external radiation is practically eliminated.

MECHANICAL DRAWBACKS

At all events, the thermodynamic prospect of the gas turbine is unusually favorable. The high expansion ratio, the simple and practical possibility of partial heat recovery from the waste gases, and the small heat losses through radiation give it a decided superiority over the usual form of heat engine. Markedly unfavorable, however, are its prospects mechanically. Operation on the constant-pressure combustion cycle compels the use of special compressors which in addition to the work of compression are burdened with that of displacement; a considerable part of the work actually done by the turbine is used up, therefore, for compression. It is evident that the losses in the unit parts of the aggregate turbine equipment, with reference to the proportionately small effective service, are very large and can become so great that in general there can be no further net work delivered.

The rapid and unexpected advances of turbine compressors, however, place the gas turbine in a somewhat more favorable light. Isothermal efficiencies of 67 per cent. have already been reached and will probably be raised to 70 per cent. Fig. 9 shows the total efficiencies, with and without heat recovery, of a complete turbine outfit based on different turbine efficiencies and assuming a compressor efficiency of 70 per cent. The solid lines apply to the condition that heat is not recovered from the waste gases; the

dotted lines are based on full recovery thereof by preheating the new charge; and according to the completeness of recovery of such heat will the actual efficiency lie between these lines. If the turbine efficiency be 50 per cent. the complete unit can, with its then overall efficiency of from 11 to 20 per cent., compete with a good steam-power installation in the matter of fuel consumption. Should the turbine efficiency be brought to 65 per cent., the overall efficiency would lie between 24 and 35 per cent. and the gas-turbine unit would then show the fuel consumption of the best gas engine.

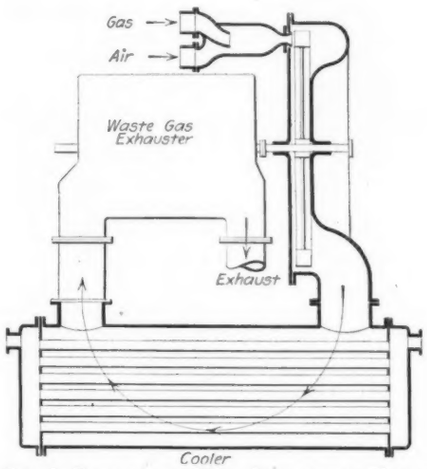


FIG. 6. EXHAUSTER USED INSTEAD OF COMPRESSOR

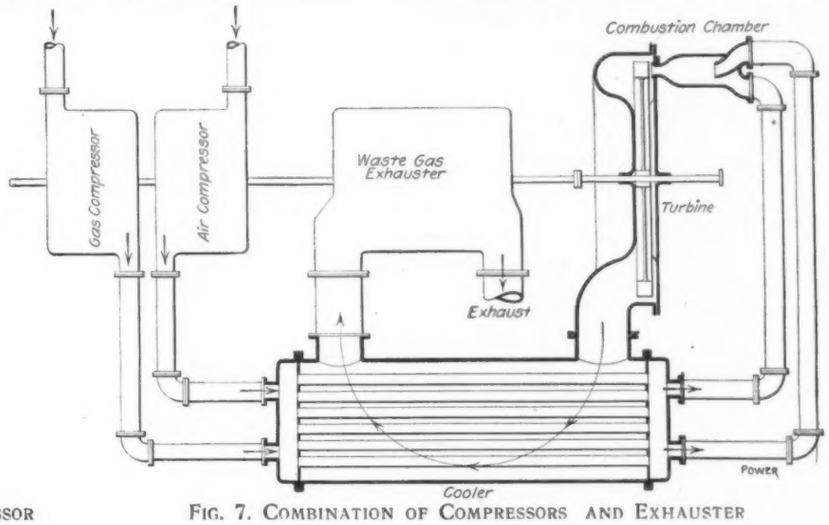


FIG. 7. COMBINATION OF COMPRESSORS AND EXHAUSTER

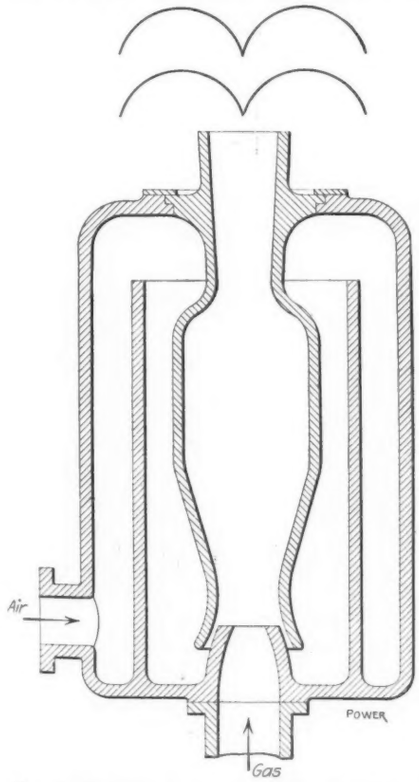


FIG. 8. PRESSURE-JACKETED COMBUSTION CHAMBER

In steam turbines, by means of suitable staging, an efficiency of 50 per cent. has been successfully raised to nearly 70 per cent. In the gas turbine, the high temperatures of the operating medium present an insurmountable obstacle in the way of a like development. If, in order to obtain a good turbine efficiency, the high-pressure gases heated to the temperature of combustion are allowed to expand in stages, the cooling of adiabatic expansion in the individual stages is so small that the temperatures of the initial wheels of the rotor become unmanageably high. In addition, through the necessity of keeping the bearings cool, such great temperature differences occur in the individual wheels that distortion thereof and consequent vibration of the rotor are unavoidable. These difficulties can be prevented by single-stage expansion, as through the assumed adiabatic expansion ratio of 50 the terminal temperatures are kept within acceptable limits. Nevertheless, the mechanical and bucket losses operate toward a poorer fuel utilization by such a gas turbine equipment than that shown by steam-power plants.

It has been variously sought to avoid temperature troubles by cooling. Still, all cooling methods result in heat losses, be the temperature reduced in the simplest way through surface action or through the introduction into the fuel of neutral media; although to that end the water spray must, from a practical viewpoint, be regarded as an attractive means, inasmuch as the hydraulic and mechanical advantages of staging, possible only through temperature lessening, very likely outweigh the heat losses. The disclosure of a favorable compromise between turbine and thermal efficiencies must be reserved for experiment. However, in the light of knowledge now available, it can be stated with certainty that an improvement in fuel utilization over that of the reciprocating gas engine cannot be expected from the gas turbine.

There still remains to be investigated the question as to whether the gas turbine can offer advantages in the way of installation and service costs. The necessity of installing a large plant places the turbine in an unfavorable position in competition with the usual heat engine. Even under the most favorable condition imaginable the output factor of the gas-turbine equipment (the effective load divided by the total capacity of the plant installed) amounts to only about 33 per cent. (see Fig. 9); for example, in order to carry an effective load of 1000 hp. there would have to be provided a 2000-hp. turbine and a 1000-hp. compressor. Hence it results naturally that an immediate saving in installation and operating costs is not to be expected. Only the need of power units the size of which would lie outside of the sphere of the reciprocating engine can bring the gas turbine within the field of usefulness.

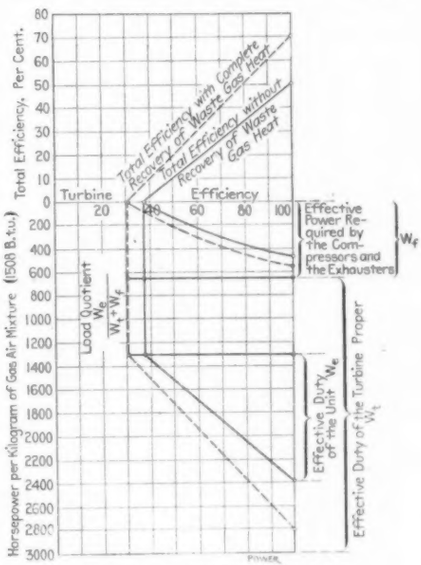

Total Efficiency, Per Cent.
Horsepower per Kilogram of Gas-Air Mixture (1508 B.t.u.)
Total Efficiency with Complete Recovery of Waste Gas Heat
Total Efficiency without Recovery of Waste Gas Heat
Turbine Efficiency
Effective Power Required by the Compressors and the Exhausters
Load Quotient
Effective Duty of the Unit
Effective Duty of the Turbine Proper
POWER

FIG. 9. POSSIBLE RESULTS

Electrical Department

Conducted to be of service to the men in charge of electrical equipment in the power house

Catechism of Electricity

Arc Lamps

1189. *How is light produced in an arc lamp?*

By passing current through two carbon rods held in line with each other with the adjacent ends a short distance apart. The current bridging the gap between the carbons produces a brilliant arc which gives to the lamp its name.

1190. *Does the arc produce all the light given off?*

No; the greater portion of light comes from the ends of the carbon rods which become white-hot under the influence of the current.

1191. *Is direct current or alternating current used?*

Some arc lamps work with direct current and others with alternating current.

1192. *Does not the current burn off the ends of the carbons?*

Yes; the ends are slowly burned away; the length of the positive carbon is reduced much more rapidly than that of the negative carbon, in a direct-current lamp with an unshielded arc.

1193. *Why does the positive carbon burn more rapidly than the negative?*

It does not actually burn more rapidly; its length is reduced more rapidly because some of the particles of carbon detached from the positive rod are carried across the arc by the current flowing from the one rod to the other and are deposited on the tip of the negative rod, replacing an equal quantity of carbon particles burned off by the arc.

1194. *Does this have any other effect besides the difference in the rates of shortening the two rods?*

Yes; the flow of current from the positive to the negative carbon hollows out the end of the positive rod and the deposit on the end of the negative carbon builds up that end into a sort of peak, as indicated in Fig. 398. The arc eats away the edge of the negative carbon tip and gradually undermines the peak, which breaks off. A new peak is then formed gradually and later broken off, and so on, until the rod is consumed.

1195. *Which carbon furnishes the greater portion of the light given off?*

The positive carbon, which has the hollowed end, or crater, as it is called.

1196. *Is the positive carbon placed above the negative one, as represented here?*

Yes, usually; in order that the intense light from its crater may be cast downward, where it is most needed.

1197. *What is the color of the light from an arc lamp?*

The color of the light depends upon the composition of the carbon rods. If there are impurities in the carbon, the color will vary considerably. Ordinarily, the light is tinged with violet but is very brilliant, closely resembling sunlight.

1198. *How much light does an ordinary arc lamp give?*

There are two common sizes of open arc lamps rated respectively at 1200 and 2000 candlepower.

1199. *How much current is required by the ordinary direct-current arc lamps?*

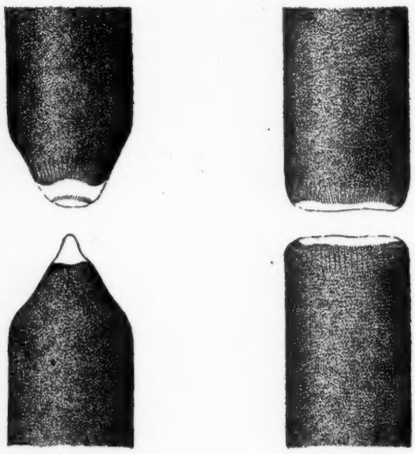


Fig. 398

Fig. 401

Direct-current arc lamps in which the arc is not protected from the surrounding air require 6.8 amperes in the 1200-cp. size and the 2000-cp. lamp takes 9.6 amperes.

1200. *What voltage is required by an ordinary arc lamp to force the current across the arc?*

About 46 volts. This includes about 3 volts to overcome the resistance of the carbons and about 3 more to overcome the resistance of the lamp magnet and connections, leaving about 40 volts applied to the arc itself.

1201. *How long will the carbons in an arc lamp burn before they have to be renewed?*

The rate of consumption depends largely upon whether the arc is "open" (not shielded), as in Fig. 399, or inclosed, as in Fig. 400. In the former case the arc is freely surrounded by air and burns the carbons rapidly; in the latter it is inclosed in a small inner glass globe that practically excludes the air, and the consumption is therefore much slower owing to the restriction of oxygen in the inner globe. The rate of consumption for an open arc ranges from 1 to 2 in. of positive carbon per hour;

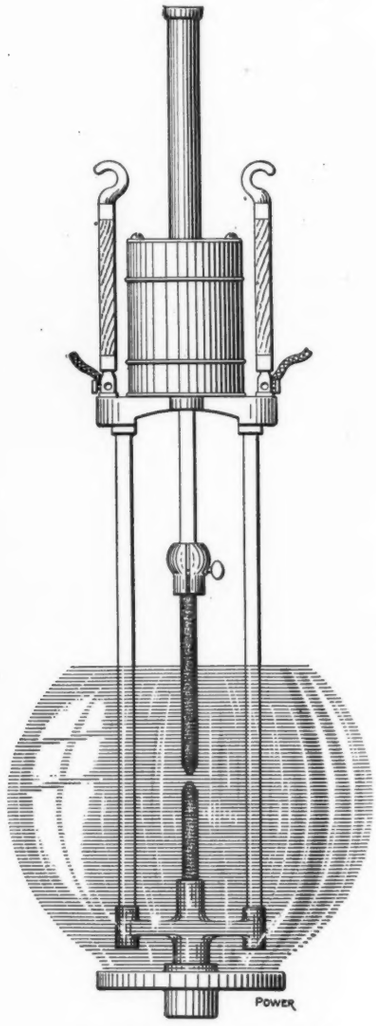


Fig. 399. Open-arc Lamp

the rate for an inclosed arc ranges from 0.07 to 0.10 in. per hour. The rate depends on the size and composition of the carbon rods and the character of the current—whether direct or alternating.

1202. *In inclosed-arc lamps is the inner glass globe perfectly air-tight?*

No; because the cap at the top of the globe is provided with a hole in the center through which the upper carbon can move freely. The downward movement

of the upper carbon is necessary in order that the proper distance may be maintained between the carbon tips to form the arc. The fitting at the top and bottom of the inner globe is very snug, however, and but little air can get in.

1203. *Does the inclosed arc possess any advantages over the open arc besides the lower rate of carbon consumption?*

Yes; the light of the inclosed arc is much softer and steadier than that of the exposed arc and in consequence is much preferable for interior illumination. Comparing Fig. 399 with Fig. 400, it will be seen that the large outer globe used on the open-arc lamp is also used on the inclosed-arc lamp, in addition to the small inner globe which incloses the arc. This makes the fire risk from sputtering carbons considerably less with the inclosed-arc lamp than with the open-arc lamp. On account of the slower carbon consumption in inclosed-arc lamps, the cost of carbons and of replenishing is less. To offset this in a measure, however, are the first cost and maintenance of the inner globes and the additional labor of keeping them clean. Taking everything into consideration, the inclosed-arc lamp is almost always preferable to the ordinary open-arc lamp; it has practically superseded the open arc for indoor lighting and is rapidly replacing it for outdoor service.

1204. *Do the ends of the carbons in an inclosed-arc lamp burn to the same shapes as those of an open arc?*

No; the ends of the carbons in an inclosed-arc lamp burn almost flat, as represented in Fig. 401. This is due to the fact that the carbons are separated farther, which causes the arc, instead of maintaining one position, to shift continually over the ends of the carbons.

1205. *Are arc lamps operated with alternating current different from the others?*

Yes; arc lamps are made especially for that kind of current.

1206. *What effect does the alternating current have upon the carbons?*

It causes both carbons to become equally luminous, and both of them are consumed in about the same time. In the alternating-current inclosed-arc lamp, the upper and lower carbons are at about the same temperature when the lamp is burning, in consequence of which more light is thrown upward than with the direct-current arc. The appearance of the carbons is very much as shown in Fig. 401, but the ends are more flat because the arc travels around the ends of the carbons even more frequently than in the case of an inclosed direct-current arc lamp.

1207. *Of what material are arc-lamp carbon rods made?*

Those for open-arc lamps are composed chiefly of petroleum coke, pulverized and mixed with tar, or a similar binding material, and molded into rods. The rods when dry are baked at a high temperature. Carbons for inclosed-arc lamps of both direct-current and alternating-current types must be made of a much finer quality of carbon because the impurities become vaporized and deposited upon the inner glass globe, reducing its transparency. Lampblack, which is practically pure carbon, is therefore employed. For this reason, and also because they must be perfectly straight and of uniform diameter so they will pass easily through the hole in the cap of the inclosing globe, these carbons cost considerably more than the carbons used in open-arc lamps.

Carbons for alternating-current arc lamps are generally cored; that is, the

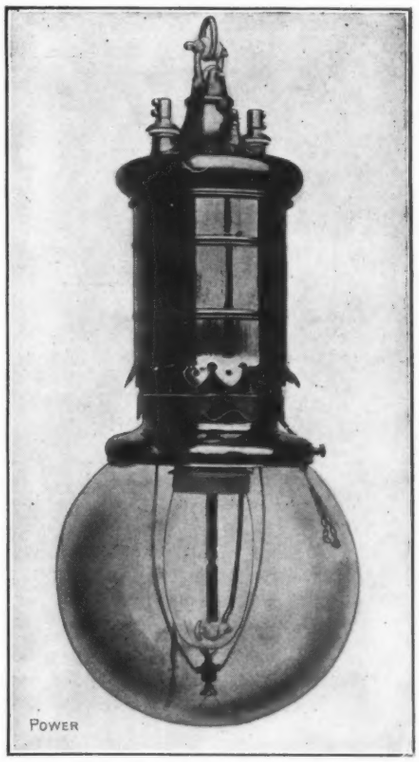


FIG. 400. GENERAL APPEARANCE OF AN INCLOSED-ARC LAMP

carbon rod is formed with a small hole extending through the center of the rod and this is filled with a much softer grade of carbon than the main, tubular portion. In some alternating-current lamps, cored carbons are recommended for both the upper and lower rods, while in others they are used only for the upper.

1208. *Why are arc-lamp carbons sometimes plated with copper?*

Carbon rods used in open-arc lamps are usually given a thin coating of copper to increase their conductivity and make them burn more evenly and for a longer time.

LETTERS

Why "Wrong" Bearing Heats

In the Jan. 2 issue there was an article by J. E. Latta entitled "The Wrong Bearing Heats." Not infrequently, bearings are found to heat without any mechanical reason or explanation for so doing, and much time is wasted in scraping, cleaning and realigning without curing the heating. In many of these cases an examination from the electrical viewpoint has shown that the heating is entirely due to the passage of an electric current through the bearings, which though of low potential may be of very great volume, and this current, passing through the resistance offered by the oil, generates heat. This current is itself generated by the stray magnetic fields from cables or from the field magnet of the machine.

It may be that this is the trouble with Mr. Latta's machine. If so, it can probably be corrected by the insertion of insulating material between the pedestal and the foundation plate, care being taken to insulate the bolts as well as the base itself. This insulating material might readily be composed of very thin paper impregnated with shellac or even without impregnation if the voltage is, as is probable, extremely low.

HENRY D. JACKSON.

Boston, Mass.

I have noticed two or three times the heating described by Mr. Latta; it is caused by the belt being excessively tight. The belt lifts the journal clear off the bottom of the bearing nearest it; consequently the other or outside journal bears only on the outside edge of its bearing. Not having sufficient bearing surface, it naturally heats. If it be possible to scrape or adjust the bearing, with liners to an inclined position, it might then bear for its whole length on the journal; otherwise it will always heat.

W. A. COOIL.

Ladysmith, B. C.

I have had the trouble described by Mr. Latta, and found it to be due to the armature not being centered (endwise) with the field-magnet pole faces. The armature had been put on the shaft too near the pulley end and the drag of magnet poles, in the effort to center the armature, pulled the journal shoulder hard against the end of the bearing sleeve at the commutator end, causing it to heat.

In order to get rid of the heating, I had to raise the commutator end of the whole machine, by means of leather shims under the sliding rail, until the weight of the armature counteracted the pull of the magnets enough to relieve the friction at the end of the box.

A. E. KERNICK.

Madison, Neb.

Heating and Ventilation

Considered as power-plant problems. Layout and operation of systems and apparatus

Annual Convention of Heating and Ventilating Engineers

On Jan. 23, 24 and 25 the American Society of Heating and Ventilating Engineers held its eighteenth annual convention in the Engineering Societies Building, New York City. Headquarters had been established in the building during the year, and as one of the associated engineering societies its first meeting was a record breaker, the registration reaching 250. R. P. Bolton, of New York City, was in the chair and with a large number of papers diversified in character and discussion previously arranged, the convention was a decided success.

On Tuesday afternoon the first session was devoted to the president's address, reports of the secretary, treasurer, board of governors and numerous committees. That added interest is being taken in the society was brought out in the report of the board of governors, which showed an increase for the year of 11 per cent. in the membership, the total now reaching 427. A noteworthy development was the organization of a New York chapter on Oct. 24, the constitution and bylaws of which were approved by a mail ballot and formally recognized at a board meeting held on the first day of the convention.

The secretary's report showed a considerable balance on hand after the heavy expenditures made necessary in fitting up the new quarters of the society.

The president's address on "The Use and Abuse of Fuel" was interesting as may be gathered from the excerpts following:

Use and Abuse of Fuel

The observant heating engineer, traveling over this country, is naturally impressed by the opportunities for the utilization of local materials for combustion, and sometimes observes incongruous conditions accompanying the apparently unnecessary use of coal. In the wooded districts, vast quantities of unused lumber rot on the ground, and along rivers and on the seacoast driftwood and wreckage litter the shores. Such materials are little utilized, though driftwood is sold in New York City at $6 a barrel, and small oak and hickory cut to length bring $16 to $19 a cord.

In portions of the country where peat could be had for the cutting, coal is brought, and I recently saw the waste of a wood-working factory being dumped into a fill, in a mill using bituminous coal at $3.50 per ton.

Natural gas can be obtained at so low a price as 30c. per 1000 cu.ft. even as far away from its source of supply as Buffalo, yet soft coal is being consumed, and ineffectively, with much accompaniment of smoke in that vicinity.

The wastage of one industry or process may be capable of supplying the fuel of a lesser, if properly applied, but it is not to be forgotten that waste materials are possibly capable of utilization in better form than combustion.

In the Northwest, millions of tons of straw and cornstalks are burned locally, and in the South vast quantities of cotton shells and fiber, capable of use either in the production of food materials or paper.

Neglect of one large opportunity is taking place in New York and in many other cities, due to their failure to utilize the waste materials of the community, which are disposed of by common expense instead of being made the means of effective heat production. Under proper furnace arrangements, the rejected ashes, which contain a considerable percentage of unburned carbon, combined with the waste wood and paper, can be utilized effectively with the garbage of a city to contribute more than the cost of the collection in providing power for other purposes. The waste materials of a city the size of Havana would, under proper conditions, afford power for all municipal water pumping and sewage disposal.

The waste materials of the Borough of Manhattan, with a population of approximately 2,300,000 persons, is annually:

Light, inflammable refuse	2,100,000 cu.yd.
Ashes	3,000,000 cu.yd.
Garbage	220,000 cu.yd.

The ashes contain approximately 20 per cent. of unconsumed carbon, representing a heat value equivalent to 168,000 tons of coal. The annual value of the ashes is $504,000, to which may be added $270,000, the cost of disposition at 45c. per yard; this makes a total of $774,000 per annum. This large proportion of wasted fuel is due to the negligent methods of operation of domestic fires, to inefficient settings and proportions of boilers and furnaces, and to ineffective drafts for complete combustion.

There is a final element in the production of coal which should make a special appeal for recognition of the evils of its unnecessary waste. The cost of coal is not paid in money alone, but in an inevitable price of human life and of injury to our fellow creatures. The terrible percentage of the loss of life to the tonnage raised which obtained in the past has been ameliorated only in the mere proportion which the number bears to the increasing tonnage raised, and not in the aggregate. It remains a fact that about 2000 lives are sacrificed each year in the production of the 550,000,000 tons of coal which we partly use and which we partly waste; and that 5000 persons, most of them hard-working men having others dependent upon their labor, are maimed and injured.

In the homes of New York alone, in which upward of 6,000,000 tons of coal are annually burned for the comfort of their occupants, the effect of 3,000,000 tons of which is largely thrown away, the waste represents a loss of 10 human lives, while the annual coal consumption of Greater New York has involved as its share of the annual loss of life 68 persons killed and 170 sorely hurt or crippled. For no other material in common use do we pay so dearly in human life and limb, yet in the use of no other material is so little care exercised, so little relative economy practised, so little educative method followed.

At the close of the reports there was still time for the presentation of two papers: One on the "Heat Exchange Diagram; Its Application to the Theory of Air Washers," by N. W. Akimoff, of Philadelphia, and the other on "Drying Apparatus," by H. C. Russell, of Washington.

Election of Officers

At the evening session the tellers of election reported as follows: president, Prof. J. R. Allen, of the University of Michigan; first vice-president, John F. Hale, Camden, N. J.; second vice-president, E. F. Capron, Chicago; secretary, W. W. Macon, New York City; treasurer, James A. Donnelly, New York City; board of governors, R. P. Bolton, retiring president; Prof. J. D. Hoffman, University of Nebraska; Samuel R. Lewis, Chicago; W. M. Mackay and D. D. Kimball, of New York City.

Wednesday Session

Wednesday afternoon was devoted to a session on ventilation. The following papers were presented: "Ventilating Questions," by D. D. Kimball; "Dust in Relation to Heating," by Konrad Meier; "Effect of Humidity and Means for Control," by J. I. Lyle; "Chemical Notes on Ventilation," by Percy Norton Evans, and a report of the committee on schoolroom ventilation appointed to act in conjunction with a similar committee of the American Association of School Hygiene.

Invitations to attend and take part in the discussion of the papers had been previously issued and a number of prominent physicians from New York City, Boston, Chicago and Springfield, Mass., were present. The doctors, of course, thought that they were the ones to decide on what was necessary and that the engineers were to produce and install the apparatus to furnish the results desired. A great deal of the discussion

hinged on the question of humidity. What was the proper and most healthful percentage? This varied with the temperature, but the majority thought it should range somewhere between 30 and 60 per cent. The entire discussion, however, revealed the fact that very little was known on the subject and that there was lots of work ahead for the society on this interesting and vital topic.

In school work it was reported that many ventilating installations had failed to give satisfaction and in some cases natural ventilation by means of the windows was better than artificial. In the majority of cases, however, this was shown to be due to the ignorance or carelessness of the janitor in the operation of the system.

The committee was continued as its work for the year had been largely preliminary and the various chapters of the organization were urged to take up the work during the coming year with the hope that they would have some interesting data to present at the next annual gathering.

Thursday Session

An informal reception and dinner took place at Murray's on Wednesday evening, and on Thursday both morning and afternoon sessions were devoted to steam and hot-water heating. The following papers were presented: "Steam Heating Large Department Stores; Its Relation to Their Electrical Requirements," by Davis S. Boyden; "Vacuo Hot-Water Heating by Forced Circulation," by Ira N. Evans; "Auxiliaries for Pressure Systems of Hot-water Heating," by J. J. Wilson; "Steam Heating from the Receiver of the Compound Engine," by Auguste Beaurrienne; "Heating of a Steam Foundry," by A. M. Feldman; "Heat Transmission with Indirect Radiation," by Frank L. Busey; "Tests of Vacuum Cleaning Tools and Exhausters," by M. S. Cooley; "Definition of the Unit of Heat," by Reginald Pelham Bolton, and "Heating a Swimming Pool," by Cesar Feran.

Due to the number of papers and an extended discussion on amendments to the constitution, only a brief interval was permissible for the presentation of each paper, so that there was but little time for comment or discussion. Such papers as will be of interest to our readers will be presented in this and later issues of POWER.

Entertainment

The entertainment program, which was arranged specially for the visiting ladies, included an inspection of the Chelsea docks, visits to the New York Public Library, the American Museum of Natural History, the Metropolitan Museum of Art and to Tiffany's. An automobile ride through Central Park and along Riverside Drive, followed by tea at the Waldorf-Astoria, was thoroughly enjoyed and the program was enlivened by two matinee parties. The Hippodrome was reserved for the last evening of the convention.

Ventilation Problems*

By D. D. Kimball

There is a large group of men who have come to believe that too much emphasis has been placed upon the measuring of ventilation by either the volumetric or CO_2 basis and that such elements as temperature, relative humidity, dust, etc., are of equal or relatively greater importance.

It is unfortunate for the cause of ventilation that many ventilation systems have been produced which have given dissatisfaction, some because of the inexperience of their designers, others because of the interference of the owners or architects in the placing or design of the apparatus; often because of a penurious policy on the part of the owner or architect, which limits the appropriation and thus the capacity of the system; not infrequently because of the poor installation of a well designed system, and very frequently because of a lack of skill in the operation of what would otherwise be a satisfactory system.

It may well be doubted whether it is known today what are the essentials of ventilation; indeed, it may safely be stated that they are not known. Many are the supposed authorities and statements supporting our present ventilation standards, but actually little, almost no, basic or conclusive data or authorities are available which are acceptable to the biologist, physician or inquiring engineer.

Without any attempt to present their relative merits, some of the important features of ventilation now advocated by different authorities are stated below. First in general acceptance in the past, and undoubtedly in the future, may be mentioned air volume. It is only comparatively recently that anything more than a certain volume of fresh air supplied and an equal amount of vitiated air withdrawn was considered essential to ventilation. It cannot now be maintained that this in itself is sufficient to constitute efficient ventilation, but neither can it be denied that this is the basis of efficient ventilation, whether the air be supplied by natural or artificial means. Whether the volumetric standards generally accepted are proper and essential may be open to question and investigation. These standards have as their basis the maintenance of a certain proportion of CO_2 in the occupied apartment. It may be possible that a less volume of air properly conditioned would give the desired results, or conversely, it may be that because of the desirability of air movement or for some other reason a larger volume of air may be required. Herein lies a field for study and investigation by practical means over a long period of time with a large number of subjects, but an investigation involving many difficulties.

Room temperature is becoming the subject of much study. It is said that 70 deg. are too high as a standard for room temperature. Of late 68 deg. have been gaining in favor. There are those who propose to lower the temperature still further. Having dropped from 70 deg. to 68 deg., is there any reason why we should not drop to 66 deg., to 64 deg., or even to 60 deg.? What governs the desirable point or how shall it be determined? It is suggested by Dr. Gulick that possibly there may be an advantage in a methodical variation of temperature; that is, having adopted 68 deg. as a standard, the room temperature should be dropped to, say, 50 deg. for a few minutes, perhaps once in two hours in the case of the schoolroom, the occupants of the room being active during this period. A variation of temperature affects the blood pressure, tones up the system and is known to be helpful in the treatment of pneumonia, typhoid and delirium.

The common demand for comfort may be depended upon to prevent too low a minimum standard, but the effects of too high a temperature, although more serious, are not so quickly noticed or so well understood.

The question of temperature is intimately linked with the question of humidity. Here again there is but little of agreement as to the value or importance of artificial humidification or proper degree of humidification. It may be stated that the normal relative humidity out-of-doors averages around 50 to 70 per cent. with large and frequent variations, and a desert would rarely be found with a relative humidity of less than 30 per cent. It is not uncommon, however, to find schoolrooms, offices and other apartments with a relative humidity as low as 15 to 20 per cent.

It is pointed out that to go constantly back and forth from such a condition to the outdoors with its much higher relative humidity subjects a person to a series of extremes most trying and injurious. In refutation of this statement an able authority points out that outdoor air, when heated in the respiratory tract, becomes just as lacking in relative humidity as the dry air within an apartment.

The nearest to an agreement obtainable on the proper relative humidity is that it should not be less than 30 or over 80 per cent.; 50 per cent. is largely used as the desirable standard, but with

*Abstract of paper read before the American Society of Heating and Ventilating Engineers, New York City, Jan. 24.

what real authority? What harm is done when the frosting of the windows compels a reduction to, say, 30 per cent.? Doubtless there is some one point or some limited range better than another.

With a higher humidity than has been customary in the past one can doubtless adopt a lower temperature, but not with a resulting saving in fuel, as has been stated in public prints. A simple calculation will demonstrate that approximately four times as much fuel is required to evaporate the water required to produce 50 per cent. relative humidity at 68 deg. temperature in the schoolroom as is saved by reducing the room temperature 8 deg. To the engineer designing ventilating systems it would be most helpful if data of acknowledged reliability were available as to the value of humidity and the proper percentage thereof.

Movement of the air is said to have much to do with personal comfort. Persons confined in a limited space without ventilation until the point of discomfort and lassitude was reached because of high humidity and high temperature, or possibly because of the depletion of oxygen in the air, have been instantly revived by the circulation of the air within the chamber by means of fans therein. Undoubtedly a film or envelope of air may form about the body, which, undisturbed by a current of air, will reach a temperature and humidity sufficient to produce serious discomfort. Probably much of the pleasure felt in the summer breeze is due to the carrying away of this body envelope and the tonic effect of the air on the skin.

It is said by some that the heating of air robs it of some vital force, changes it in some mysterious or unknown way, or adds something undesirable to the air, this complaint being especially addressed to steam-blast coils. It may be that a sufficient amount of fine dust containing organic matter will pass through the filter or otherwise reach the steam-heated surface, producing ammonia in harmful quantities, or it may be that some of the oxygen or ozone of the air is consumed by the process of oxidization of the dust.

Ordinarily one thinks of the air as composed of approximately nitrogen, 78.30 per cent.; oxygen, 20.70 per cent.; carbonic acid, 0.04 per cent.; watery vapor, 0.01 per cent.

In reality the air contains other constituents to which but little consideration has been given in the study of ventilation problems. One of these, ozone, is known to be a most active element, and it is now being quite extensively used in the treatment of pneumonia.

In the past a great deal of dependence in estimating the efficiency of the ventilating system has been placed upon the determination of the amount of CO_2 in the air, 6, 8 or 10 parts CO_2 in 10,000 parts of air being regarded as proper standards for hospital, school and factory ventilation, respectively, but since it has been discovered that a person feels no discomfort in an atmosphere containing 200 or more parts CO_2 in 10,000 parts of air if the temperature and humidity are kept within certain bounds, less dependence is placed upon the CO_2 standard and more emphasis is placed upon the need of proper temperature and humidity.

Is it not possible that the full significance or effect of some of the other gases in the air, or the inter-relation thereof, is still unknown, or that there are even other gases still unknown, which in some way or measure may have a bearing upon the subject of ventilation or the subject of air warming? This is essentially a subject of investigation for the chemist or the biologist rather than for the ventilating engineer, but like other problems, it can best be solved by a harmonious working together of the two.

Recent experiments give substantial basis for the belief that the vegetable matter combined with the dust of the air coming into contact with heating surfaces above 160 deg. or 170 deg. distils ammonia, carbon-monoxide and perhaps other gases, in some cases to a harmful degree. It would seem as though this could be best prevented by proper washing of the air or by a limitation of the temperature of the heating surfaces to 160 or 170 deg., or by both processes.

The value of direct radiation, because of the effect of its radiant heat, which is compared to the radiant heat of the sun as desirable and healthful, is a question worthy of serious thought.

The problem of the best method of testing the effect of ventilation and its different elements is not the least of the ventilation problems. The psychological element enters so largely that calorimeter tests or measurement by means of ergographic tests are not generally acceptable. No other acceptable method of measuring the effect of ventilation upon the individual has been suggested.

The method of determining this which finds the most favor is that proposed for the work of the special committee on school ventilation in which it is proposed to take one or more large school buildings occupied throughout by children of the same grades and condition, treating one-half of the building in one way and the other half in another way, carrying on the treatment for a period of months and measuring its effect by the relative standing of the pupils and their relative condition as to health, weight, etc., as described in the report of that committee.

Briefly summarized the phases of ventilation now believed to be worthy of serious study are as follows:

Volume of Air—The present standards are questioned. By a proper study of temperature or humidity could they be decreased or should they be increased?

Temperature—The present standard (68 deg. for the schoolroom and home) is said to be too high. Shall it be lowered and, if so, to what point?

Variation of Temperature—A periodical reduction of temperature is said to be desirable.

Humidity—Is artificial humidification of occupied apartments desirable, and, if so, to what degree?

Movement of Air—This is said to be desirable. When can it be employed and to what extent can it be carried without involving injurious drafts? What of a frequent "flushing out" or perflation?

Heating of the Air—May the air be harmed or in any way affected in the process (assuming the air to be free from dust)?

Cooling of the Air—Is this desirable in occupied apartments and will it involve undesirable attending features?

Dust—It is stated that dust is extremely harmful. What is its effect, how best eliminated, and how generally should such means be employed?

Organic Matter from the Breath or Body—What is its nature and effect?

Chemistry of the Air—Is there anything connected therewith worthy of further investigation? What of ozone?

Relation of ventilation to exercise and work.

Methods of determining the effect of ventilation and its different elements upon the individual.

Although many of the so called failures of ventilating systems in the past may have been due to inexperience of the designer, and many more were doubtless due to lack of skill in operation, it is believed that much of the condemnation of artificial ventilation heard from eminently reliable medical authorities and others is due to the failure of the ventilating engineer to give as much attention to the conditioning of the air as to its volume.

It cannot be denied that the engineers are providing ventilation fulfilling the existing standards, but these standards are not of their creation but were given them by biologists, physicians and scientists in the past. Questions of the percentage of oxygen required, percentage of CO_2 permissible, effect of temperature and humidity, question of organic matter in the air, etc., are not engineering questions. It is but the duty of the engineers to meet those standards which are demonstrated and given to them by the biologist, physician and scientist.

If, therefore, the apparatus provided by the engineer has failed to give satisfaction it is not that the apparatus or engineer has failed but because the

standard provided them has failed. If this is a fact, the biologist or physician should determine wherein the existing standards are wrong and they should determine new standards supported by authoritative tests and experiments. Then the engineers may be trusted to provide ventilation fulfilling the new standards.

Heating a Swimming Pool*

By C. Teran

A swimming pool is generally a luxury, not a necessity. For this reason not many are built, and a description of the system installed for Herbert Coppell at Tenafly, N. J., may prove of interest.

It is housed in a building of one story, and includes the pool room, two dressing rooms, boiler and coal rooms, all on the ground level. The pool is sunk below grade, is built of concrete, waterproofed and lined with English size enameled brick. It is 38 ft. long, 15½ ft. wide and 6 ft. mean depth below water level. The cubical contents are, therefore, 3534 cu.ft.

The heating plant was designed to heat this volume of water in 10 hr., or at the rate of 353 cu.ft. an hour. Ten hours is a convenient length of time for heating the water, because the required apparatus is not specially large. If the apparatus was much smaller it would, of course, require a longer time to heat the water, and this time added to that necessary to empty and clean the pool would make the period of time which the pool would be out of commission too long. The time required to empty and clean this pool is 4 to 5 hr.

The installation includes two cast-iron sectional boilers, a Berryman service heater and a filter. The water is reduced to 30 lb. pressure on entering the building. It is then heated in the Berryman heater by steam generated in the boilers, and then filtered and discharged into the pool. For filling, a main inlet is used; this enters the pool at the deep end near the bottom; there is also a nozzle above the water line which is used to produce a spray over the pool.

On account of the proximity of the walls of the pool to the outside ground a loss of heat in the water was anticipated and provision made to replace the loss. Careful consideration was given to the various methods that could be used to accomplish this purpose, and injecting water heated to a high temperature into the filled pool was decided upon. The reason for using a high temperature is that the water is not taken from the pool to be reheated, as this would necessitate a circulating pump, but fresh water is used, and by heating it to a high temperature a minimum quantity of water is required and less coal burned. The water is injected at four points on each side of the pool near the bottom, through nozzles passing through the brick lining and flush with it. This arrangement gives a good distribution, and is neat in appearance. It is found that during the winter months the water loses 2 to 3 deg. F. in 24 hr.

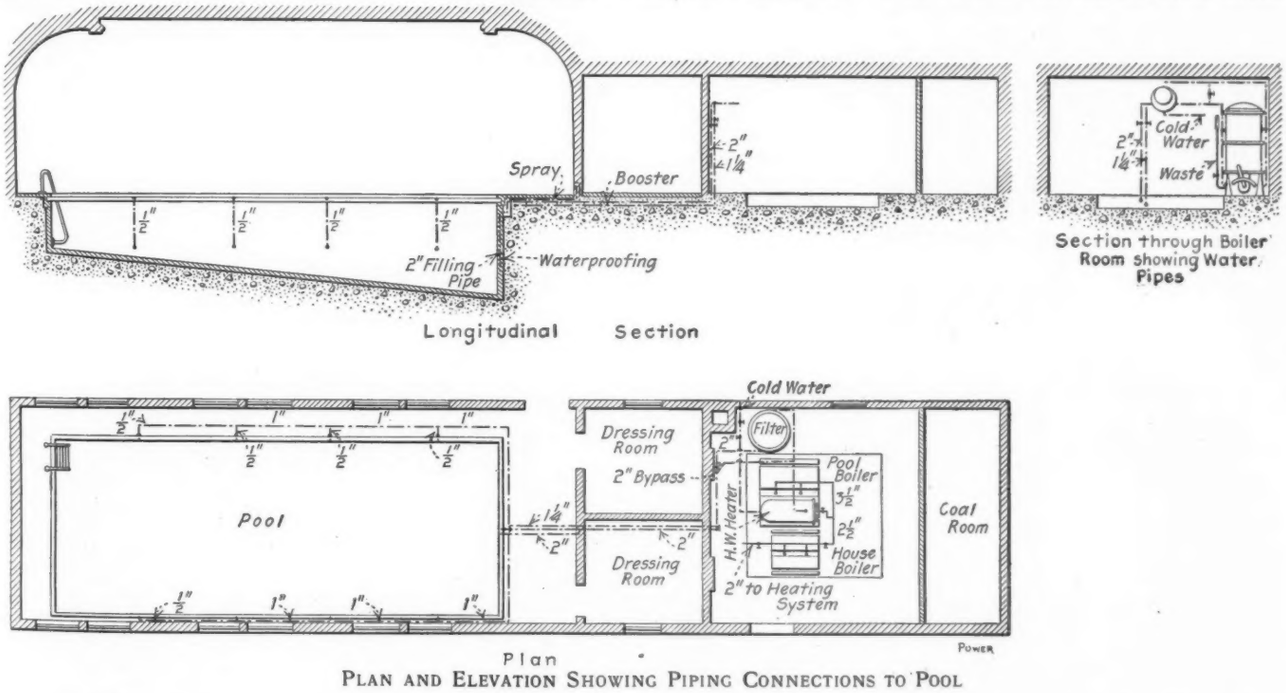
In filling the pool the water is heated to 75 deg. F., which, on account of heat losses in transit, etc., gives an ultimate temperature of 70 deg. F. The water injected to make up the heat loss is heated to 180 deg. F.

The large boiler is used to heat the water when the pool is being filled. This was computed as follows:

Contents of pool	3534 cu.ft.
Water to be heated per hour	353 cu.ft.
Water to be heated per hour	353 × 62.4 = 22,027 lb.
Rise of temperature of the water	40 to 75 = 35 deg.
Heat units transmitted to water per hour, 22,062 × 35	771,000 B.t.u.
Coal necessary to be burned per hour, 771,000 ÷ 8000	96 lb.
Grate area, 96 ÷ 8 =	12 sq.ft.

A boiler having a grate 40 in. wide by 48 in. long was installed. The other boiler shown is used to heat the building and the water injected into the pool to make up the daily loss of heat; by this arrangement, the necessity of keeping a fire in the large boiler is avoided. As there was no sure method of predetermining the loss of heat of the water in the pool, in selecting this boiler liberal allowance was made for this purpose above what is required to heat the building. The amount of direct radiation is 400 sq.ft., all behind screens; the boiler is rated at 1000 sq.ft. and has a grate 21x27 in. or about 4 sq.ft.

The service heater was specified of proper size to heat 2800 gal. of water per hour from 40 to 80 deg. F. with low-pressure steam, and it was left to the manufacturers who furnished it to design the proper size heater for this duty. The filter was specified in a similar manner. No automatic temperature control was installed, and none has been found necessary. An even temperature of the water is attained by maintaining a steady fire and regulating the flow of water by hand.



Plan and Elevation Showing Piping Connections to Pool

*A paper read before the American Society of Heating and Ventilating Engineers, New York City, Jan. 25.

Corrugated Film Boiler Feed Water Heater

Among the specialties recently brought out by the Schutte & Koerting Co., of Philadelphia, is what is known as the spiral corrugated film feed-water heater, views of which are shown in Figs. 1 and 2.

The principal features of this heater lie in the concentric spirally corrugated tubes, which construction, besides constantly agitating the water and preventing the formation of cold cores, keeps the water in a thin film between two heated surfaces, thus making a combination that should give an exceedingly high rate of heat transmission.

In Fig. 1 is illustrated the arrangement of the corrugated tubes in the heater and also the path of the water between the two corrugated surfaces. The outer tubes are expanded into headers, and the inner tubes are then screwed into place and the outer joints made tight by nuts which are securely locked. This construction is shown in Fig. 1.

All expansion and contraction of the tubes due to heating and cooling is taken up by the floating header, which is free to move endwise. This feature reduces the possibilities of leakage to a minimum.

The steam enters through the opening in the center of the shell and passes through small holes which are drilled in the shell and act as a baffle-plate, thus preventing a direct jet of steam impinging upon the tubes. The steam is therefore distributed about the outer tubes and inside of the inner tubes, the condensed water draining off through the opening at the right-hand bottom end of the shell. The feed water enters at the bottom of the end connection, shown in Fig. 1, and passes through the film formed by half the tubes to the floating header, and then through the other half of the tubes and out at the top opening shown at the end of the sectional view. These heaters are made in 16 sizes in both vertical and horizontal styles.

Fig. 2 shows an end view of a heater and the manner in which the heads fit in the outer casing.

Howard Ball Valve

Perhaps there is nothing in the power plant which is so misused as the blowoff valve; it is often hid away in a most inaccessible place and it is frequently neglected and abused. For these reasons, and because of the severe character of the service which it must perform, a successful blowoff valve must be simple and rugged.

The accompanying illustrations show the Howard Ball Valve for blowoff and other services where ordinary cocks are used. A hollow ball of bronze with openings at opposite sides fits into a suitably formed body of the same material. The ball is turned by means of a box wrench which fits over the square head of the stem. A quarter turn opens the valve full or closes it tight. The valve is kept tight by means of suitable packing which is fitted into a recess in the discharge end and retained there. Thus,

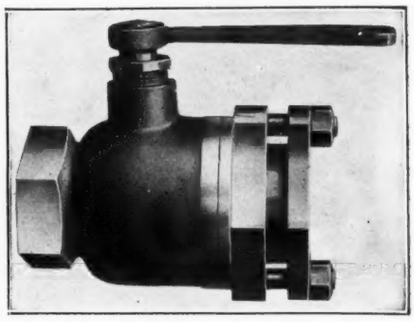


FIG. 1. THE HOWARD BALL VALVE

this packing is supported on three sides by bronze.

The principal feature of this type of valve is the fact that there is no metal-to-metal friction as the ball comes in contact with the packing only. Thus wear is reduced to the minimum and the life of the valve is greatly increased. It is claimed that under very severe conditions it is necessary to repack the

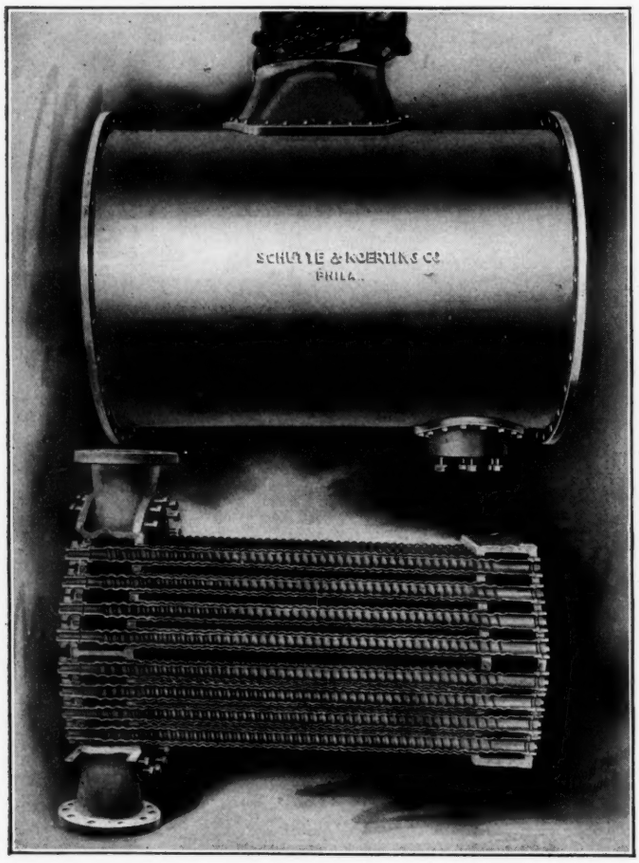


FIG. 1. HOW THE TUBES ARE ARRANGED

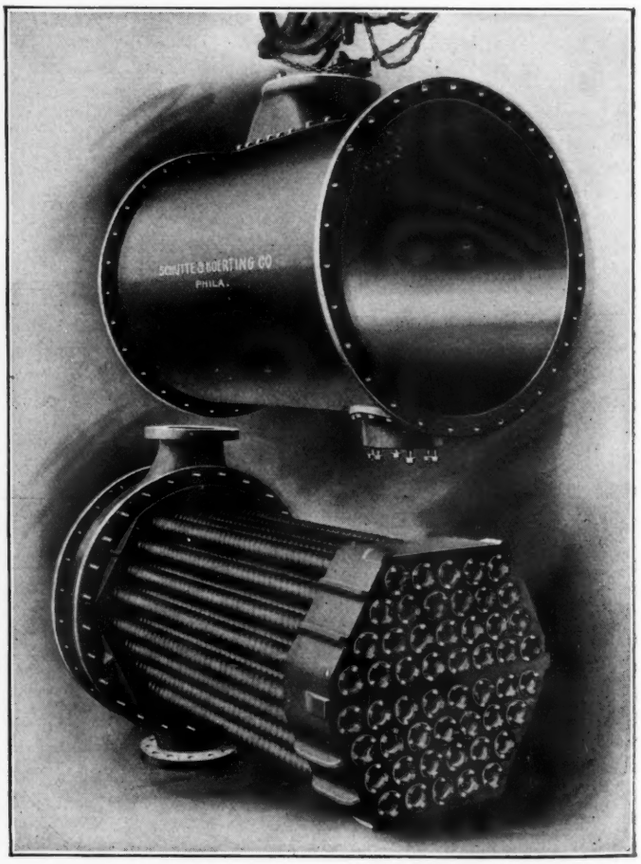


FIG. 2. END VIEW OF TUBE HEAD

valve about once a year, and under more favorable conditions, less frequently.

Some of the other points of superiority claimed for this valve by its manufacturers, the Howard Iron Works, Buffalo, N. Y., are as follows:

It is made entirely of special bronze, there is no chance for the metal to corrode or be affected by boiler or other injurious compounds. All valves are

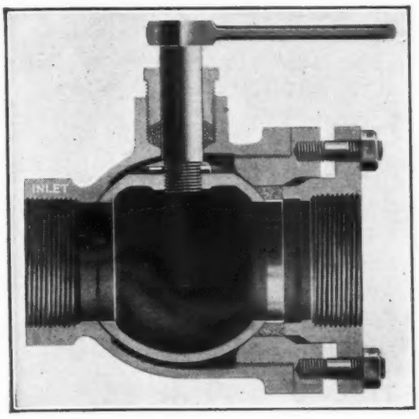


FIG. 2. SECTIONAL VIEW

made for a working pressure of 300 lb. and the fitting is designed to withstand strains due to water-hammer. Because of its construction, the greater the pressure, the tighter the fitting becomes. As the valve has no complicated adjustments, there is nothing to get out of order, and it does not require the attention of an expert to keep it in good condition. It is impossible for the valve to stick, and no sediment can lodge in it. The valve is easily operated even under high boiler pressure; it offers the full area of the pipe opening, when open, and the passage is straight through, thus preventing the accumulation of foreign matter. Sediment cannot affect the ball and the seat is self-wiping and cleaning. The large bearing surface of the valve is made for durability. The packing can be easily, quickly and cheaply renewed.

Improved Furnace

An improved furnace has recently been patented and assigned to the Parson Manufacturing Co., 149 Broadway, New York City. It is illustrated in Figs. 1 and 2, the first showing a front elevation, and the second a side elevation.

The fuel is introduced into the furnace at the front, in which an arch is constructed. The fuel-feeding mechanism consists of one or more hoppers, each of which is supplied with a fuel pusher consisting of a movable platform loosely interlocked, and given a reciprocating motion by an eccentric carried on a shaft in front of the boiler setting.

By means of suitable angular displacements of the eccentric, the pushers can be operated at predetermined intervals. The shaft carries a ratchet wheel which is actuated by a pawl carried on a rocker-arm attached to a reciprocating rod. This pawl permits a close adjustment or regulation of the angular motion to be given to the shaft.

Fuel is discharged from each feeder unit upon the platform set under an arch in the front wall of the furnace where the layers of fuel can receive the full heat of radiation.

The layer of fuel is first coked on its inner or advancing edge and then pushed beyond the plate or platform, where it breaks off and drops in a broken state upon the hearth below.

This mechanism consists of a frame having a chain grate running upon sprockets and actuated by a ratchet and pawl mechanism. The grate-frame casing for the greater part of its length toward the rear is closed at the bottom so as to form a channel in which the grate bars on their return convey the ash deposits from the rear to the front of the ashpits. At the back of the furnace there is an inclined grate hinged at the back and resting upon the chain grate, thus forming a part of the hearth surface.

Back of this there is a movable dumping grate that can be moved into a recess in the bridge-wall. The inclined grate guides the ash and unconsumed fuel upon the dumping grate, where the accumulation effects a seal against the bridge-wall. The incline and the dumping grates may be perforated for the admission of air so that combustion may take place on them and thus form additional active hearth surface.

At the front of the grate beneath the dead plate is a hinged apron which rests upon the grate bars or upon ashes covering them. The apron extends some distance within the furnace beyond the edge of the dead plate, and the fuel is coked and dropped upon the extension of the apron; the coking is completed there and the fuel is then drawn off upon the grate bars as they move toward the rear.

At one side of the furnace there is a small ash conveyor which takes the ashes from the bottom of the ashpit to the grate under the apron and deposits them upon the grate as it travels toward the end of the furnace. Although a certain amount of ashes drops through the grate opening, the artificial application of ash to the grate, and the usual rate of feed may be such as to purposely cause an accumulation of ashes upon the dumping grate against the bridge-wall. Here it will normally be maintained until it becomes excessive, when this surplus is conveniently discharged by withdrawing the dumping grate.

The ash acts as a seal at the front and rear of the grate, which causes the air supplied to the ashpit to pass up through the grate. The fuel passes slowly through the combustion area resting on the layer of ash deposit.

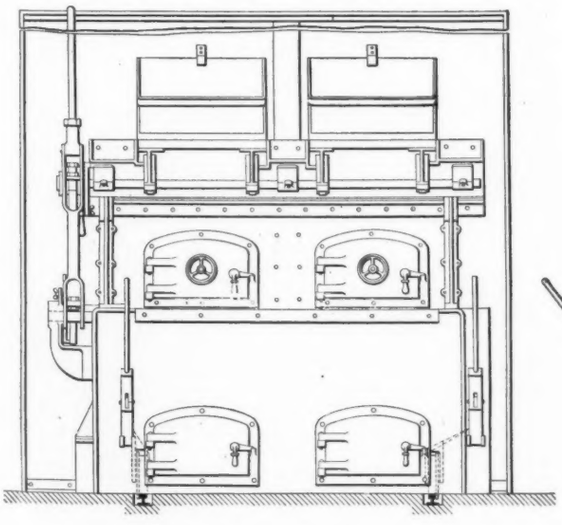


FIG. 1. FRONT ELEVATION

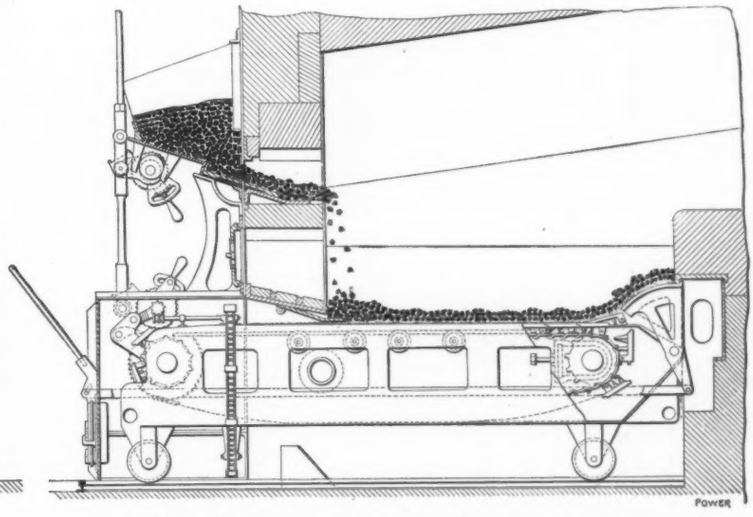


FIG. 2. SIDE ELEVATION OF THE IMPROVED FURNACE

Oster Bent Pipe Threading Machine

The increasing use of bent pipe for conduit and other purposes has created a demand for a pipe machine which will thread pipe when so bent. Such a machine, shown herewith, is developed by the Oster Manufacturing Co., Cleveland, Ohio.

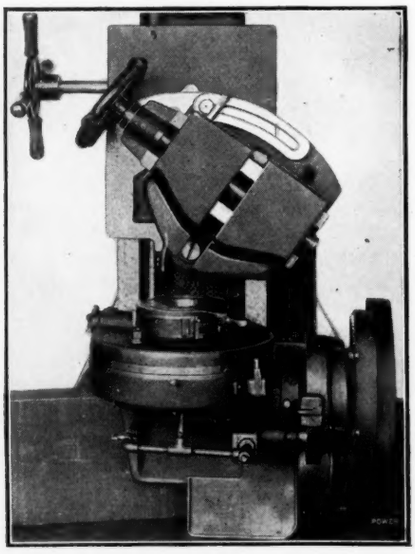


FIG. 1. TOP VIEW OF BENT-PIPE THREADING MACHINE

Fig. 1 is a view looking down on the machine. The swivel vise will stand at any necessary angle to thread pipe bent on a radius from 6 to 24 in. This vise is locked in position and the pipe is held in its jaws in the ordinary manner. The slot in which this lock is placed is so graduated as to enable the operator to place the vise at any desired angle.

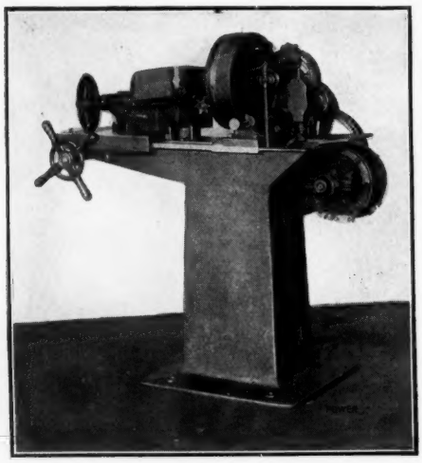


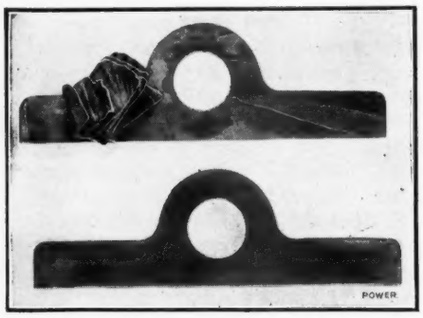
FIG. 2. SIDE VIEW OF PIPE-TRHEADING MACHINE

When threading straight pipe, the vise is locked in its normal position, and the machine becomes an ordinary pipe-threading outfit, good for all job purposes, even to threading pieces as short as 3 in. without the use of any special nipple jaws. The machine is also equipped with an automatic knock-off so that threads of a standard length can be easily made.

The present line of machines is developed up to 2-in. pipe only. Special machinery will, however, be made to order up to and including 6-in. pipe.

Shim for Bearings

The halftone shows a new and remarkably clever shim, composed of a series of layers of brass 0.002 in. thick, firmly held together by a film of solder of no appreciable thickness. Adjustment is made by lifting one end of one or more of the layers and peeling off. The rest of the shim remains as solid as



LAMINATED SHIM

ever after the layers are removed. This shim is applicable to all classes of machinery where split bearings are used. This metal can be obtained in sheet form and cut to suit. It is manufactured by the Lindhe Shim Co., New York City, N. Y.

United States Overfeed Stoker

Under date of Jan. 2, page 24, a description of this overfeed stoker was published, in which it was stated that a continual stream of water passes through that portion which is in direct contact with the burning fuel. This statement was the same as submitted by the makers, who request us to make this correction. The circulation of water is very rapid and intermittent, being under control of a check valve. When the grates are started in operation the check valves are opened; as soon as the water has flowed in and filled the grates this check valve automatically closes, preventing the inflow of any more water until that which is lying in the grates is flashed into steam. When this flashing takes place all of the steam and water in the grates is flashed very rapidly into the steam space of the boiler, carrying with it any foreign substance in the tubes that are cast in the grates. As soon as this flashing takes place the check valve is again opened and a fresh supply of water taken in. The flashing is very rapid, taking place at intervals of about eight seconds when the stoker is in operation.

Important Boiler Tests

To determine the comparative merits of the Jacobs-Shupert sectional firebox and the ordinary type of stay-bolt firebox for locomotive boilers, a comprehensive series of tests are being conducted by Prof. W. F. M. Goss at the Jacobs-Shupert Co.'s works at Coatesville, Penn.

Three distinct groups of tests are to be made. The first consists of tests to determine the relative amounts of heat absorbed by the fireboxes of the two boilers under similar conditions of operation. The original construction of each boiler provides a diaphragm which separates the water space into two compartments, one including the tube surface and the other the firebox surface. In the course of the tests these compartments are to be fed separately with weighed water, an arrangement permitting a separate determination of the heat transmitted by the firebox and by the tubes respectively. These tests will also show the relative heat-transmitting capacity of a unit area of firebox-heating surface as compared with a unit area of tube surface.

The second set of tests will be made with the diaphragms removed. It is also expected that information will be secured concerning the circulation in the boilers.

After the completion of the foregoing tests the boilers will be removed to a location where their explosion will result in no harm to surrounding property, and are to be tested for strength under low-water conditions. The instruments of observation are to be placed within shelter and all precautions are to be taken to insure the safety of the spectators. Under these conditions each boiler is to be subjected to a progressive series of tests until the destruction or serious deformation of the firebox occurs, the series to be carried out substantially as follows:

The boilers are to be operated under normal conditions at a predetermined rate of power and the feed is then to be cut off until the water level reaches the upper surface of the crown-sheets. The feed pump will then be started again and the water level restored, after which the pressure will be reduced and a careful examination made of all parts. This will be repeated, lowering the water level successively 1, 3, 6 and 12 in. below the crown-sheet.

In order that the fire may be under control at all times at a safe distance, oil fuel has been selected.

The Jacobs-Shupert United States Firebox Co. has announced that it will be glad to have any engineers interested present at the tests.

The first of the tests was begun on Feb. 1 and the low-water tests are scheduled to begin about Apr. 1. The exact dates, however, may be had a few days in advance by applying to the above mentioned company at Coatesville, Penn.

Issued Weekly by the
Hill Publishing Company
JOHN A. HILL, Pres. and Treas. ROB'T MCKEAN, Sec'y.
505 Pearl Street, New York.
122 South Michigan Boulevard, Chicago.
6 Bouverie Street, London, E. C.
Unter den Linden 71—Berlin, N. W. 7.

Correspondence suitable for the columns of POWER solicited and paid for. Name and address of correspondents must be given—not necessarily for publication.

Subscription price $2 per year, in advance, to any post office in the United States or the possessions of the United States and Mexico. $3 to Canada. $5 to any other foreign country.

Pay no money to solicitors or agents unless they can show letters of authorization from this office.

Subscribers in Great Britain, Europe and the British Colonies in the Eastern Hemisphere may send their subscriptions to the London Office. Price 21 Shillings.

Entered as second class matter, December 20, 1910, at the post office at New York, New York, under the Act of March 3, 1879.

Cable address, "POWPUB," N. Y.
Business Telegraph Code.

CIRCULATION STATEMENT

Of this issue 29,500 copies are printed.

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

Contents

	Page
Plant of Capital Traction Co.	208
Use of Oil in Steam Lines	211
James Watt in Cornwall in 1781	212
Samuel Reynolds	214
Raising a Water Tank	214
Various Types of Steam Meters	215
Progress in British Marine Engineering	218
The Gas Turbine	219
Catechism of Electricity	222
Why "Wrong" Bearing Heats	223
Annual Convention of Heating and Ventilating Engineers	224
Ventilation Problems	225
Heating a Swimming Pool	227
Editorials	231-232
Readers with Something to Say: Sampling and Analyzing Coal....Cure for a Hot Bearing....Sheet Packing and Gaskets....A Deranged Governor....Starting a Plant Shut Down for a Year....What Changes Are Necessary?....New Water Finder....What Caused the Rod to Wear?....An Inexcusable Loss....Does Cold Air Cause Leaky Pipe Joints?....What Cracked the Ells?	233-235
Questions Before the House: Erecting Steel Stacks....Belt Lacing....Home Made Damper Regulator....Breakage of Separator Gage Glasses....Brick for Boiler Walls....License Laws....Water Softeners....Value of Compression....Value of CO_2 Recorder....Feed Water Regulators....A Collegian's Come Back....Some Load....Using the Firm's Stationery....Sand for Hot Boxes....Home Made Water Heater....A Vacuum Puzzle	236-240
Inquiries of General Interest	241

POWER

Secretary Fisher on Water Power Development

The annual report of the Secretary of the Interior, which has just been made public, shows an intimate knowledge of the present conditions affecting water-power development in the United States and points out a course whereby the present chaotic situation may be eliminated and still preserve both Federal and states rights.

The inadequacy of the provision now included in Federal grants, making a tenure revocable at the will of the administration, is pointed out. This theoretically tends to increase the risk involved and gives an excuse for demanding unusually large returns upon the investment, in spite of the fact that experience has shown no such risk to exist. Furthermore, such a provision tends to discourage water-power development.

Mr. Fisher is of the opinion that the Federal Government has ample constitutional right to control the water powers both on navigable streams and upon the public domain; in fact, Federal control is often necessary where long-distance transmission involves interstate commerce.

Summed up in a few words, the report recommends that the Government lease water-power privileges upon the payment of rentals which shall be adjusted at periodic intervals. When the period of readjustment arrives the Federal Government will inquire into the condition of the grant, and if the grantee has been furnishing good service at reasonable rates and making a fair profit, there will be no reason for raising the rentals. If, on the other hand, the grantee has been permitted to make an unduly large profit at the expense of the community, the Federal Government can increase the rental and thereby indirectly reimburse the public.

The question of fixing rates and regulating service is to be left entirely to the state or community and all returns from rentals of the power sites are to be used in improving the flow conditions or for other local improvements. In this way the benefits are to revert to the state.

The argument that rentals must necessarily increase the price paid for power by the consumer, is answered by pointing out that most towns supplied by hydro-electric power also have steam-generated power, and that the cost of producing the latter will necessarily fix the selling price of all the power.

Heretofore, the absence of any definite policy has resulted, in some instances, in the granting of special privileges contrary to the best interests of the people, while in others it has hindered the development of important water powers. Now that the Federal Government has signified a willingness to do its part and has outlined a tentative plan, it is time for the states to step into line and offer their earnest coöperation.

Valves in Steam Lines

In a broad sense, valves in a steam line may rightfully be considered as a necessary evil. This statement is rather startling at first thought, but when all of the difficulties, disadvantages and dangers in connection with their use are fully realized the truth of the statement will be well appreciated. Of course, some valves are always necessary, but the number should be kept at a minimum. Stop valves on the boilers, as well as a valve at the junction of each branch to the main line, are always indispensable, but often additional valves are inserted at various points merely to cut out a part of the steam main. Such valves are usually superfluous and are more detrimental to the system than otherwise.

The greatest disadvantage resulting from a multiplicity of valves is, perhaps, their obstruction to the flow of the steam. This engenders a drop in pressure between the boilers and the steam consumers which means a certain efficiency and, therefore, a monetary loss day after day as long as the plant continues to operate. For this reason such types should be installed that offer the least impediment to the free passage of the steam.

Attention should also be given to the question of condensation and, where necessary, the valves should be properly drained to prevent the accumulation of water which might be picked up by the onrushing steam and perhaps result in a blown-out cylinder head or other damage.

Another disadvantage of a multiplicity of valves is their constant care in keeping the packing tight. Any leaks due to poor or loose packing can be easily noticed and repairs made at once, but wire drawing and internal leaks are not so noticeable and they sometimes lead to considerable trouble and even danger. For instance, if there are two valves closed and the one nearest the boiler allows steam to leak through while the other one is perfectly tight, the steam pressure will build up in the line between these two valves and become a source of danger, particularly as such a condition is usually unexpected and, therefore, not provided for.

The proper, accessible location of the valves should always be borne in mind when laying out a steam line. In many plants the question of proper valve location has been so little considered that his life is endangered every time a man essays to close one, for should there be an escape of steam while he is operating the valve, he would either be scalded or have to take big chances and drop to the floor. Oftentimes a small platform is built directly over the steam line to which the valve stem is carried. This is a poor arrangement for in case of accident there is no possible way for the man to escape as he would be in the direct path of the steam rising from the break in the line below.

The placing of valves in pits should also be avoided; if it is absolutely necessary to do so, then the valve stem should always be extended to the floor level above, from which point the valve can be closed or opened without any danger.

Ventilating engineers complain that their work is hampered by the interference of owners of buildings and architects. Operating engineers can sympathize with them. Until steps are taken to prevent this ignorant interference, fool managers will continue to rush in where wise engineers tread with extreme caution.

How the Central Station Got One Plant

The engineer looked over his plant and was proud of it. For years he had been chief over nine or ten men who were doing work that could easily have been done by six men.

So far as the chief knew, the central-station solicitor had never dreamed that there was a chance to do business with the owners of this plant. But Mr. Solicitor was merely biding his time, and his time finally came, much to the surprise of the engineer.

This chief is an every-day, ordinary engineer, just like thousands of others who work in large cities. He had allowed his boilers to become dirty, the tubes were covered with scale and the efficiency of his plant ran behind in other respects. One day the inevitable accident happened; the entire plant was shut down and things were at sixes and sevens. Current for light and power was in urgent demand.

Here was the chance for which the central-station solicitor was waiting; he could put in motors and electrical connections in a few hours, and he did. The engineer had his excuses ready as to the cause of the accident, but the thing of the greatest moment to all concerned was that the central station had gained a foothold, with the probability that its service would remain in that plant, and that the engineer would have to go.

And he did; he is now looking for a position. The central station is changing all of the useful steam-driven machinery to motor drive, and many of the old machines are being removed and discarded; useless lengths of piping are being taken away, and one of the two boilers has been condemned. In a short time this plant will be electrically equipped throughout, and the chances are very strong that the central station will remain as the dominating factor in its operation.

The story has been told—nothing added, nothing withheld—and there is but one conclusion to reach: The engineer of that plant was inefficient; he either did not know his business or he was blind to his opportunities and to his own interests. He lay back, took things easy; in fact, sold his birthright for a mess of pottage.

How many more are there like him?

"To Earn More, Learn More"

"Learning while getting a living" is the headline on a newspaper story of how some young Westerners do both while paying their way in college and acquiring industrial knowledge in a shop. And there are 500 applications for 150 vacancies in the freshman class this term. "To earn more, learn more."

A five-ton fire engine recently did duty on the streets of New York sandwiched between two huge placards warning people against throwing away lighted matches. This may seem spectacular, but it drew an attentive crowd. It might be well to mount the next exploded boiler on a four-horse truck and draw it through the streets placarded with the cause of the explosion. Perhaps it would decrease the number of boiler accidents.

The New York physician who said recently that there is no such thing as artificial ventilation seems to agree with the college professor's celebrated lecture on the snakes in Ireland: "There is none." If the medico will revise his opinion by stating that in his hospital practice he has not always met with the best of ventilation, he will appear to agree with many of the ventilating engineers.

POWER is in receipt of a number of articles on "Running a Steam Turbine," but more are wanted. Send in a clear, brief story of how you would run a steam turbine; illustrate it with rough sketches. The editors will put the article in shape, if necessary, and the artists will attend to the drawings. You may win the fifty-dollar prize. Turn back in your file to Dec. 26 and study the conditions of the contest.

Old steam boilers under sidewalks are a menace to the public which the boiler-inspection department of New York City is supposed to safeguard. Better put some of them out on the scrap-heap.

If your employer still believes that the beginning and end of your vocation is keeping the water boiling, it is probably your own fault. It may be that this is the reason why he turns a deaf ear when you want more money.

Readers with Something to Say

A letter good enough to print will be paid for. Ideas, not mere words, wanted

Sampling and Analyzing Coal

When samples of other than small coal are to be taken, some difficulties arise which cause considerable work. The sample should be a fair specimen of the coal in general, and fair to both dealer and consumer.

With one engineering firm it was customary to tell the coal agent that an analysis of the coal would be made and if the contract was let the coal delivered must be kept up to the analysis. The agent, to be obliging, would send as a sample a lump of coal that would grace a mineralogist's cabinet but be absolutely useless for analysis, or a letter of introduction would be given to some consumer who out of courtesy would insist on getting the sample from the coal-pile himself, which would be equally ill fitted.

If the coal to be tested was lump coal and in the car the sample was taken while the car was being unloaded; if one of the smaller grades, the sample could be taken by digging along the sides and middle of the car, straight down to the bottom. If taken from the boiler room I usually managed to be there while the coal was being delivered and thus got a sample from the pile as well as from the wagon. The amount varied with the size and the condition of the coal. For lump and block more was taken, until a sample containing a fair run of the coal was obtained. If the coal showed seams of slate the pile was thoroughly gone over to estimate about what percentage of the lumps contained slate. The sample was then placed in a pile and mixed, broken into pieces about 3 or 4 in. square and the pile quartered. Opposite quarters were taken and the process continued until the coal was broken into pieces about ½ in. square. For taking the coal to the laboratory a tin pail holding about 5 lb. and fitted with a tight cover was used.

In the laboratory the coal was again broken into pieces of about ¼ in. and exactly 5 grams weighed and placed in the oven at a temperature of 225 deg. F. for one hour to expel the moisture. Up to the time of placing the coal in the oven the work was done as rapidly as possible as in breaking the coal more opportunity was offered for the loss of moisture. A fair sample of the coal in the bucket was taken and ground in a Parker mill and 2 or 3 oz. pulverized in a mortar till fine enough to pass through a 100-mesh sieve. This is mixed and quartered and about 1 oz. retained for the final analysis of volatile matter, fixed carbon and ash. Two tests are made by which to check.

The calorific value of the coal was found with a Parr standard calorimeter for B.t.u. per pound of coal, for the B.t.u. per 1c. and the B.t.u. per pound of hydrocarbons. From these readings calculations were made to determine the heating value of the coal as it was delivered, with the moisture still in it, and also on the coal with the moisture expelled. The third calculation was for pure coal; that is, coal containing only volatile matter and fixed carbon.

The difference between the B.t.u. per 1c. for dry coal and wet coal shows how much can be lost by a fireman continually wetting the coal. The tests made were for coal used in 18 or 20 buildings and were made without notice to the engineers or firemen, but when the log sheets showed the manager that the coal was falling off in quality.

The report of the analysis was made on a card similar to the one shown and filed for reference.

Name of coal.....
Location of mine.....
Name of dealer.....
Date of test.....
Price per ton.....
Sample from.....

	Wet	Dry	Pure
Fixed carbon			
Volatile matter			
Moisture			
Ash			
Total			
B.t.u. per pound			
B.t.u. per 1c.			
B.t.u. per pound of hydrocarbons			
REMARKS:			

THOMAS H. WATSON.

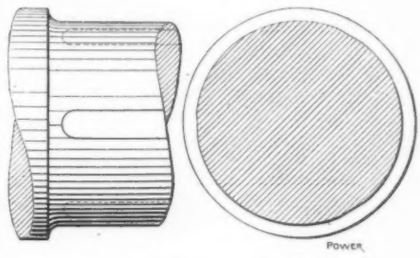
Chicago, Ill.

Cure for a Hot Bearing

A short time ago, one of the main bearing journals of a large Corliss engine under my charge gave considerable trouble by warming up.

Many and various remedies were tried for preventing it without any real success until I happened to tell my troubles to a neighbor engineer who gave me a cure for hot bearing journals which, when applied, proved successful and stopped further bearing troubles.

The cure consisted of cutting three flat places along the shaft as shown by the accompanying sketch. This method, I was told, was a common practice among old-timers in Lancashire 30 years ago. My friend had it down to a standard, the flats being made ⅛ of the shaft diameter wide and the lengthwise cut was within ⅛ of the shaft diameter of the journal ends. That is, for an 8-in. diameter journal, the flats should be 1 in.



FLAT PLACES ON THE SHAFT

wide, and extending to 1 in. of the journal ends.

My friend also said that this method was applied on new machinery made in the north of England about this time. Is there any reason why it should not be adopted today?

F. P. STRACHAN.

Belfast, Ireland.

Sheet Packing and Gaskets

The two principal points regarding a good packing job are the cutting of the packing and the putting it into place; after that comes the quality of the packing. Have the packing as thin as possible; $\frac{1}{32}$ and $\frac{1}{16}$ in. are best, though ⅛ in. is good in some places.

Do not load up on all the varieties made, even to please a salesman, for just as sure as this is done the waste will grow proportionally. One salesman will advise a red packing and another black, and both will prove that they are right. Because a packing tears easily in the hand is no real proof of its poor quality.

Do not buy packing suitable for superheated steam for medium steam pressures, 100 lb. and less, because it is a waste of money. In cutting sheet packing into gaskets for flanges, steam and water cylinders, steam chests, etc., use the knife more and the hammer less. Under equal conditions, a poor quality of packing cut with a knife will give better satisfaction than a better grade cut with the hammer in the flange. Do

not be afraid to use the dividers, rule and pencil in laying out packing.

It is all right to place the packing against the flange and tap it lightly with the hammer for marking, but on no account hit sufficiently hard to cut the gasket; use the knife for that, as the hammer tears it. To save time, men will sometimes cut the bolt-holes out with the peen end of the machinist's hammer. This is bad practice and is the cause of many blowouts at the bolt-holes.

Never place one gasket on top of another to make a tight joint. If the flanges do not face properly, a gasket will not answer the purpose. That is what a "dutchman" is for.

As to what constitutes a good sheet packing or gasket, here is an instance that will verify what I stated at the beginning of my letter, it depends upon the one putting it in: The valve in question was a 3-in. globe valve, the steam supply to a fire and general-service pump of 750 gal. per min., and using steam at 80 lb. pressure.

This pump runs 24 hours a day for about six weeks, when its companion takes the next shift, and they have both been doing so for 12 years.

It was necessary to remove the valve bonnet to replace the valve disk; and this was the first time it was removed in all that period. The gasket on it was a single loop of common cotton string, the ends simply crossing one another in the form of an "X."

Equally as important as cutting the gasket and putting it in place is the coming up on the bolts with the nuts. It is understood that the faces of the flanges are thoroughly cleaned for this operation.

Just watch a first-class engineer come up on the bolts on his engine cylinder head or steam chest when replacing them. Note how carefully he comes up on them all, little by little, paying particular attention to each one in turn as the task is nearly done. One or two bolts are not put under a severe strain while the rest are being brought up to proper tension, but the pressure is divided equally and gradually on them all. The inclination to come up tight first on one bolt, then follow with the next, and so on, is the cause of many blowouts at the bolt-holes. The cheapest part about any gasket is its original cost; putting it in is the expensive part. Graphite mixed with cylinder oil is an old and excellent thing to apply to the face of one of the flanges, so the valve bonnet or steam chest may be easily removed without destroying the gasket.

Many users of sheet packing call for packing with cloth insertion for cold-water service, but equally good results may be had of packing without it, as well as saving the expense of an extra line of packing. Watch the dollars; packing runs into dollars very quickly.

A noticeable fact is that nearly every time an expert—one of the maker's own men sent to make good a machine or appliance—has a job of this kind, especially on engines and pumps, and either end of the latter, he seems more anxious to get heavy wrapping paper for gasket material. As these men are working on their companies' own time, they must certainly know what is best both for service and lasting qualities. Salesmen have actually laughed at such absurd purchases as ¼-in. thick sheet packing, and say that there is absolutely no gain in its use. Of course, diaphragm packing requires a special packing.

An excellent tool for cutting bolt-holes in a gasket is a punch made of a short piece of pipe having one end ground to a sharp edge. Place the gasket on a board and hit the punch with the hammer. It is best to have a set of these punches to suit the various size bolt-holes needed.

By using ring gaskets there is certainly a saving on material. The average mechanic in using sheet packing wastes a great deal of it, and instead of using the scraps, which at times are amply large for small work, he will hack off a generous piece from the roll and in turn add to the junkpile. Make sure the gasket is a good fit, no crimping in it; see that the bonnet or flange fits even and comes up uniformly on the bolts, and a good job is assured.

SCOTT NORTON.

Springfield, Ohio.

A Deranged Governor

I had an interesting experience some years ago down in western Tennessee, in a small lighting plant; the engine was a small high-speed affair and it was giving trouble from racing.

I had been sent for to indicate the engine and try to locate and remedy the trouble. When I arrived at the plant, at about 9 p.m., the superintendent was at the switchboard and the engineer at the throttle valve, trying to maintain sufficient light to "pull off" a show which was in progress in a theater of the town. After midnight we shut the engine down to ascertain the trouble. I found only one governor weight on the engine, and asked the engineer where the other one was. He said it was over in the corner; they had tried the weights every way they could think of and got better results without the other one. I looked the engine over and found the eccentric to be only about 30 deg. ahead of the crank. At this I was not surprised, but when I discovered that the eccentric was keyed to the shaft in this position I began to wonder, for I knew the engine had previously run in a power plant at Nashville, Tenn., and was bought by these people second-hand.

I asked the engineer if the eccentric was keyed to the shaft when they got it and he informed me that it was. I then asked if they had made any repairs on the engine; he informed me that a local machinist made a new crank disk for the engine.

This, of course, made matters clear, for I knew then just what had happened. The machinist who repaired the engine paid no attention to the position of the keyway in the old disk, or to the relation of the eccentric to the disk when he came to cut the new keyway, but just cut it any place that came handy. Fortunately, there were two setscrews in the eccentric over the key, so we took out the key, set the eccentric in proper position and put in the other governor weight. After a few adjustments we had a nice-running engine and secured some good indicator diagrams.

H. R. ROCKWELL.

Alton, Ill.

Starting a Plant Shut Down for a Year

Rules to observe by an engineer on taking charge of a steam plant that has been shut down for one year are as follows:

Remove all boiler manhole and handhole plates, get into the boiler and look for signs of grooving and pitting; then see that all braces are sound, testing them by tapping with a hammer. The feed pipe should be examined to see that it is not filled with scale; also see that the discharge is not directly on the tubes or against the shell.

Remove all scale from the shell and tubes and before coming out of the boiler examine the blowoff pipe and know that it is sound and not filled with scale. The outside inspection consists of examining the brickwork, and repairing the setting if necessary; also put new sections in the grate if they are needed.

Examine and test the steam gage and safety valve and know that they are in good working order, also examine the the pipes leading to the water column and clean them out. The water column may or may not be set properly with respect to the boiler tubes. Set it so that when the water is 2 in. over the top row of tubes it will just begin to show in the glass. The feed pump should be newly packed and put in good condition. The feed water heater requires attention for it may be filled with scale; the pipe connecting with it may also be badly scaled.

When the engine is reached take off the cylinder head, and the steam-chest cover. If the cylinder is rusted it should be cleaned by the use of oil and the rust removed. The valves should be set properly and the seat put in good

condition, and all old packing on the piston rod and valve stems should be removed and new packing substituted. Examine the bearings of the engine before starting up and if they are cut or scored, scrape them until they present a smooth surface and adjust them until they are a proper fit.

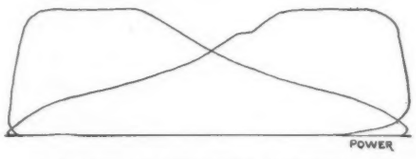
When everything has been put in running order, proceed to start up as under ordinary circumstances.

WILLIAM GOAL.

Gibsonburg, Ohio.

What Changes Are Necessary?

I would like to have readers of POWER tell me what they think of the accompanying diagrams and what change would be necessary to obtain the best results.



IS VALVE ADJUSTMENT NECESSARY?

The diagrams were taken from an Atlas four-valve engine.

J. D. GILMORE.

Hillsboro, Ill.

New Water Finder

Technical papers, when they make a news item of any miraculous scheme, invariably make the write-up so as to expose the "nigger in the wood pile." It is thus that these papers have built up for themselves a character of solid worth and they can be depended upon by the readers. But a recent number of a supposedly technical paper gave me an acute attack of "spinal come and git us." The caption of the article was "A New Water Finder," and when I read that "for finding water up to a depth of 200 ft. the instrument costs $150," I instinctively turned to the "Buyers' Guide" and "Index to Advertisements" to learn the price of stock, the bonus of "common" with the purchase of each share of "preferred," etc. The instrument can be readily used by unskilled persons, of course. The article said in part:

> The principle on which the instrument works is the indicating of the presence of currents which flow between the earth and the atmosphere, and which, seeking the path of greatest conductivity, are always strongest in the vicinity of subterranean water courses, the waters of which are charged to a certain degree.

Would not that frost the pipes of your vertebral refrigeration system? If not, how is this?

> The instrument indicates water courses flowing underground in a natural state, and not water pipes and sources that have sprung up to daylight. . . . . Observations should always be taken on a fine, calm, clear day between 8 and 12 in the morning and 2 and 5 in the afternoon, these being the hours of greatest activity of the vertical earth currents.

F. WEBSTER.

Philadelphia, Penn.

What Caused the Rod to Wear?

I have a spare 16x36-in. engine which has run daily from about 5 p.m. to 11 p.m. for the past five years. The piston rod got so I could not make the packing hold when the engine was loaded, and upon examination I found that the part of the rod in the cylinder when the engine was standing was smaller than the rest. I always stopped the engine with the crank-end crankpin over the center on the lower quarter as the engine ran over. This left about 12 in. of the rod in the cylinder.

The rod is round and in fine shape; the part in the cylinder is also round, but it has become smaller than the other part, and when the steam valve opens on the crank end the steam will blow out in a puff and the rest of the stroke will be all right.

The rod has had the best of care, it never was hot, and it was packed with four rings of soft packing which is never run tight. Why should the section of rod in the cylinder wear?

A. E. KERNICK.

Madison, Neb.

An Inexcusable Loss

Why is it that when the manufacturer has studiously designed his engine with the least possible clearance practicable, that the erecting man will so often carelessly put in long nipples between the cylinders and the drain cocks?

I know of two high-speed engines running at 275 r.p.m. which have a ¾-in. nipple 6 in. long, an ell, and a 12-in. nipple on each drain between the cylinder and the drain valves. In 10 years of service the loss on each of these engines, with coal at $3 or $3.50 per ton, will amount to quite a sum.

The above is an example where the nipples are unusually long. But ½-in. nipples from 6 to 10 in. long are common in the usual work of pipe-fitters, with a loss of steam due to condensation during the life of the engine. Where there are many auxiliary engines about a plant, the combined loss is a big item.

At a speed of 200 r.p.m., with 10 years the running life of an engine, both nipples will uselessly be filled with steam at full boiler pressure 2,102,400,000 times.

Therefore, the nipples should be made as short as practicable, or better still, drain cocks should be provided and screwed directly into the cylinder.

ROSCOE S. HELVIE.

Havana, Cuba.

Does Cold Air Cause Leaky Pipe Joints?

I have often heard that a draft of cold air in the vicinity of steam pipes will make the joints leak. The only explanation that I have ever heard is that the flanges contract; no mention of the bolts also contracting.

If cold air really makes pipe joints leak, I would like to have it explained. I have studied the matter somewhat and from experience I can arrive at but one conclusion—it is a fallacy.

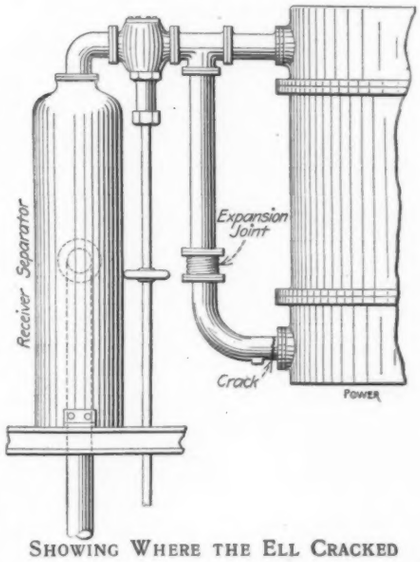
A good joint does not leak, cold air or not, but a joint may be leaky and the leak may not be visible on account of the small amount of escaping steam, in a very hot, dry atmosphere, when the steam is absorbed by the air before it is condensed. If cold air is admitted near the same joint, the steam is condensed before it is absorbed by the cold air.

WILFRID NORMAND.

New Bedford, Mass.

What Cracked the Ells?

The accompanying sketch shows the arrangement of the steam connection to the high-pressure cylinder of a 30, 60 and 90 by 66-in. triple-expansion engine. The ell at the bottom cracked all the way around with the exception of about



SHOWING WHERE THE ELL CRACKED

5 in., the break coming in the fillet to the flange.

This is the second ell breaking at the same place, but on different engines. Can some reader of POWER suggest a reason for these breaks? The cylinders are steam-jacketed.

H. R. BLESSING.

Philadelphia, Penn.

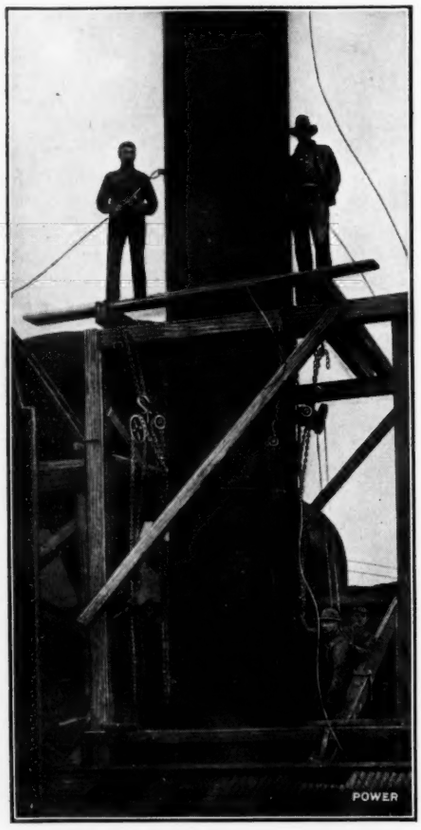
Questions Before the House

Comment, criticism, suggestions and debate upon various articles, letters and editorials which have appeared in previous issues

Erecting Steel Stacks

I saw an article recently in POWER on raising steel stacks. The following plan is, I think, far superior to using a gin pole; in fact, a stack can be raised by this plan about as quickly as a gin pole can be raised.

Use is made of three or four sets of chain blocks and a band of as many pieces, which, after being clamped on the stack, will leave room enough between the ends to hook the chain blocks to the bolts. Each course of the stack is riveted on the longitudinal seam and



SHOWING STACK IN COURSE OF ERECTION

the band is clamped upon the first course, which is raised high enough to clear the second course. This course is then put in place, and riveted at the roundabout seam to the first. The bolts of the band are then slackened and the band is lowered to the under side of the roundabout seam where it is again clamped to the stack and the stack is raised to allow a third course to be riveted on at the bottom. This process is continued until the stack is completed.

At the proper places the guy bands are riveted and the guy wires anchored to steady the stack. As each course is put in place the guy wires will have to be slackened in order that the stack may be raised.

The accompanying figure shows the erection of a 60-in. by 75-ft. stack according to the plan just outlined.

H. A. TITCOMB.

Bellingham, Wash.

Belt Lacing

I have noticed that in all of the discussions on lacing belts the use of wire is regarded as rather unsatisfactory.

I know from long experience that if belts up to 8 or 9 in. wide are properly laced with small soft iron wire it is not possible to get as good results in any other way.

Holes should be punched with a small awl or the end of a file about $\frac{3}{8}$ in. apart and not over $\frac{1}{16}$ in. from the edge. The wire may then be sewed in by hand, going twice through each hole and leaving it straight on the inside of the belt with the ends looped under one of the strands at the finish. Then the lacing should be put on the smallest pulley and pounded well into the leather. Failure to do this is what makes the wire break off.

There is no need to have a machine to do this work; it can be done just as well and more quickly with the belt hanging on the shaft. With a little practice, one can get a joint that cannot be noticed with the belt either running or idle, and the results will be fully equal to those secured with an endless belt.

The belts on woodworking machines are subject to very hard usage, but I have had 5-in. belts running at 5000 ft. per minute over 5-in. pulleys work for three months and the wire still show no signs of wear; in fact, all of the belts had to be taken up long before the wire gave out.

To put in new lacing, take a pair of snips and cut across the belt, then pull out the ends with pinchers, using one set of holes over again if the belt is to be shortened.

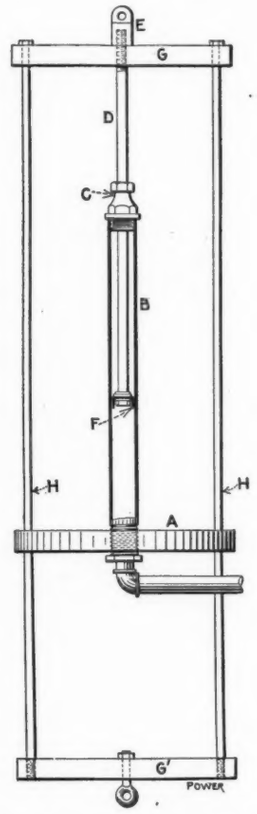
When rawhide lacing is used the holes pull out and an otherwise good belt becomes too short and worthless. This never happens with wire and a dollar's worth of it is sufficient in a big mill for a year.

V. L. BALLOU.

Shirley, Mass.

Home Made Damper Regulator

In POWER for Jan. 2, A. Seimes inquires for the design of a home-made damper regulator. The accompanying figure shows one that, while it will not control to a fraction of a pound, will nevertheless work fairly well.



SHOWING CONSTRUCTION OF REGULATOR

Referring to the figure, *A* is a cast-iron flange about 8 or 9 in. in diameter, drilled through the center and tapped for 1-in. pipe. Two $\frac{5}{32}$-in. holes are drilled on a line through the center and at a distance of 3½ in. from it for the ¼-in. guide rods, *H*. The cylinder *B* is of 1-in. brass pipe and about 12 in. long. One end is threaded and screwed into the flange *A* and the other end is

fitted with a small stuffing-box *C*. (A bonnet from an old valve will answer nicely.) The hole in the stuffing-box should be ⅜ in. in diameter for the piston rod *D*. This rod should be of brass, ⅜ in. in diameter and about 14 in. long. Both ends are threaded, and on one end is a leather disk *F* securely fastened and of a neat fit for the 1-in. pipe. The other end is screwed through a small piece of square iron *G* and then locked by screwing a piece of iron rod *E* on top. This piece in turn has a small hole drilled through it for connecting the damper wire.

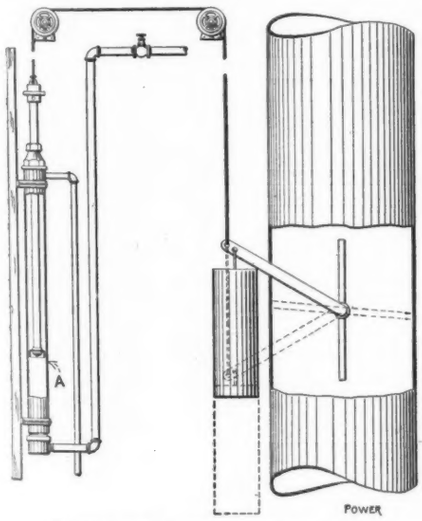
The top piece *G* also has two $\frac{5}{32}$-in. holes drilled 7 in. apart for the ¼-in. guide rods, which are of sufficient length to allow a clearance of about 4 in. when the piston is all the way up. The bottoms of the rods are threaded and screwed into another square piece of iron *G'*, as shown. This iron has a ½-in. hole drilled through the center and an eye-bolt fitted in to carry sufficient weight to balance the boiler pressure.

Below the flange *A* there should be a 1x¼-in. bushing screwed into the 1-in. pipe and a small ¼-in. nipple and elbow for the steam connection. Two ½-in. holes should be drilled through the flange *A* before assembling so that it can be bolted to a bracket when complete.

GEORGE H. HANDLEY.

Newburgh, N. Y.

The accompanying figure illustrates the design of a simple and easily constructed damper regulator which I have used in my plant with good results.



EASILY CONSTRUCTED REGULATOR

The main cylinder *A* is a piece of 1-in. brass pipe 12 in. long with the cap of an old globe valve fitted onto one end. The other end is capped and a ⅜-in. pipe is screwed into this cap to form the connection with the boiler. A ¼-in. drain pipe is connected into the top end of the cylinder to get rid of any water that may collect on top of the piston. The piston rod is of ½-in. round iron. A leather-cup piston is held in place on the end of the rod by suitable washers and nuts.

The construction of the other parts of the regulator is self-explanatory.

MARTIN MCGERRY.

Holley, N. Y.

Breakage of Separator Gage Glasses

In the Jan. 9 issue, J. W. Dickson complains that he cannot get glasses to hold in separator gages and wonders if other engineers are having the same trouble.

In my plant there are two separators and we have found it almost impossible to get glasses to hold in them; the traps that discharge them blow glasses as fast as the separators. My reason for the trouble is the higher temperature to which the glass in a separator is subjected. The water stands in a boiler glass and I believe it cools to a much lower temperature than a separator glass for the separator is constantly getting a new supply of steam, thus having less time in which to cool. We have not broken a boiler glass in two years, but the same kind of glass will not hold in a separator.

EDGAR ALTMAN.

Cincinnati, Ohio.

Brick for Boiler Walls

In reply to the inquiry of Lewis L. Scheiderer as to hollow brick for boiler settings, I would say that I have been for two years in a plant having four 150-hp. return-tubular boilers. Two of them have been installed 14 years and the other two 8 years.

The settings of the first two have an outer wall 12 in. thick and an inner wall, 17 in. thick, with an air space between. The other two settings are solid.

The settings with the air space radiate less heat, "draw" better and stand extreme changes of temperature and frequent applications from the hose better than the solid settings, which are all cracked and warped.

If I were installing boilers, I would prefer hollow settings.

C. R. WARREN.

McArthur, Ohio.

In answer to Mr. Scheiderer's question in the Jan. 9 issue concerning hollow brick for boiler settings, I will say that in our plant two 300-hp. water-tube boilers in a battery are set as follows: On one side there is an 8-in. concrete wall cast in one piece against an 8-in. firebrick wall. Building paper was placed between the two walls to prevent a bond and to allow the brickwork to expand without cracking the concrete. On the other side there is an 8-in. concrete wall cast against a 4-in. hollow-tile partition wall which separates the concrete from an 8-in. firebrick wall.

The load carried is very regular and, as far as I have been able to tell, there is no difference in outside temperatures between the two walls. The hollow partition tile are laid so that there can be no air currents circulating in them. In both cases the firebrick only go to the second row of tubes from the bottom; above this point a solid 16-in. concrete wall is carried. The concrete does not rest on top of the firebrick. A space of 2 in. or more is left for expansion and to allow for variations in thickness of the firebrick when it comes to replacing them. The partition wall between the two boilers is of solid firebrick.

B. B. HOOD.

Winona, Mich.

License Laws

In the Jan. 9 issue, J. C. Hawkins states that the license laws are not what they should be because too little attention is given to the applicant's knowledge of safely operating engines and boilers. Mr. Hawkins chooses as an example the safe speed of flywheels and the safe operation and faults of different kinds of governors. He asks how many engineers are ever examined on these two subjects.

In Massachusetts there is seldom, if ever, an examination in which the applicant does not have to show his knowledge of the safe speed of flywheels. Not everyone is required to figure the bursting speed of a rim, but the question is asked in some way so that by his answer the examiner will know what his knowledge is of the speed of a given engine.

If an applicant in this state was examined and granted a license without answering questions on different types of governors, their operation, etc., he would think the examiner let him off easily. We are not only asked the principles of governors, but what effect different changes would have in the running of the engine, what the effect would be if the cause were a break in some part, and where to look for cause when the effect is given by the running of the engine.

Valve setting is about the only real work the applicant can do in the examiner's office, and when he is examined on this subject it is to find out how thoroughly he is acquainted with the practical duties of his vocation.

Mr. Hawkins also says that the examinations on boilers and piping should be more strict. I cannot see how they could be more so, in this state, and give a just examination. We are examined on the proper placing of piping to allow for expansion and drainage, and the proper placing of valves on all lines leading to and from the boiler.

Massachusetts bases its classification of licenses on the size and number of boilers in the plant, and pressure is also taken into consideration in the fireman's clause.

I do not agree with Mr. Hawkins when he states that old boilers should be under the care of the higher class engineers. An applicant is examined on the care and repair of old boilers and given a license only when the examiner thinks he is competent to handle them.

G. B. LONGSTREET.

Somerville, Mass.

Knocking in Air Compressor

In the last paragraph of the letter under the above title, by Frank Richards, published in the Jan. 30 issue, on page 165, the word "switched" referring to the crosshead should have been "swiveled."

Water Softeners

I read the letter by J. C. Hawkins in the Jan. 9 issue in which he asks for information in regard to water softeners.

Like other pieces of apparatus, a water softener has no brains, and it is necessary to put in certain chemicals, in certain proportions, at certain times. The quantity is determined by an analysis of the water. If the water softener is properly looked after, and properly designed, it should be able to soften the water so that there will be no scale in the boilers using the softened water.

Analyses of samples of water from points not far from Hyattsville, Md., show that the cost of softening the samples submitted was in the neighborhood of 1c. per 1000 gal. for the lime and soda ash required. Probably the average throughout the United States would be from 1c. to 2c. per 1000 gal. Of course, many hard well waters go considerably above this, but if it is necessary to use a hard water for boiler purposes, the cost of softening is more than repaid by the saving made in fuel, boiler repairs, etc.

There are several records of waters treated where their scale-forming material was so high that it cost over 15c. per 1000 gal. to soften them, yet the expenditure was more than repaid.

A water if only partly treated, say, by some so called purifying and heating processes, in which the carbonates might be removed and the sulphates left, might give rise to an extremely hard scale which would be difficult to remove, but by first analyzing a water and then using the proper proportions of lime and soda ash, the scale-forming sulphates are entirely removed and the carbonates reduced to such a point that they will not give rise to scale. When using such a water it is only necessary to occasionally shut down for washing out the very small amount of soft mud which comes from the treated water.

A careful investigation of water softening and an inspection of plants where first-class softeners are in operation will show that the boilers are entirely free from scale when the softener is properly operated, and that in a properly constructed machine very little time or attention is required to look after it.

F. S. DUNHAM,
WITH THE KENNICOTT CO.

Chicago, Ill.

Value of Compression

Referring to the editorial in the issue of Jan. 9 and the recent discussions on the subject of compression in steam-engine cylinders, I would say that in all steam engines, except straight-line air compressors and pumps which have sufficient resistance at the ends of their piston strokes, compression is a necessity, not only to secure quiet running but also to minimize repair bills. These are really the only valid excuses for its employment.

In filling clearance space by means of compression, the result can never be anything but net loss. We first generate power, by the transformation of heat, a portion of which is transmitted as the output of the engine, while the remainder is stored in the flywheel and other moving parts; we then exhaust the heat-carrying medium, with the exception of a portion, which is retained for cushioning, and proceed to employ the power stored in the flywheel to compress this low-tension steam into the clearance space, thus regenerating heat. The question is then: How can we reasonably expect to get back as much heat as we have expended in the process? The fact is, we cannot, as that would mean perpetual motion.

I do not doubt that heat is invariably less costly than its equivalent, in mechanical power. True, they are mutually convertible, but not without loss whichever way we attempt the conversion; therefore, in our efforts to produce power economically we would probably do better if we devoted more time to the study of how to get rid of that which has been spent. In other words, when the steam has once given up its useful energy, it should be exhausted as quickly and completely as is consistently possible.

Recognizing that compression is one of the necessary evils, I have always limited its production in a steam engine to such an amount as would just insure quiet running.

The work of various experimenters has conclusively demonstrated that not only is there no gain with compression, but that as it is increased, the losses due to it increase proportionately, which is just the result which I have observed in practice.

It is my opinion that the operating engineer has a very small chance to improve the economy of steam engines, his field being limited to the correction of derangements of valve setting which may occur in service, and that the only place where a material improvement is possible is on the builder's drawing-board, where the prime factors of economy—clearance and valve events—are laid down rather inflexibly.

CHARLES F. PRESCOTT.

Philadelphia, Penn.

Value of CO_2 Recorder

While I agree with Mr. Weaver in his letter in the issue of Jan. 9, that, in general, recording instruments are inductive as well as necessary to the economical operation of power plants and, while I believe in CO_2 recorders for test work, I differ with him in regard to their use in gaging the work done by the men in the fireroom. I base my statement on observations made in a plant containing 10 water-tube boilers of 4500 total horsepower.

When the CO_2 instruments were introduced an expert ran a test on one boiler and, if my memory serves me, 16 per cent. of CO_2 was obtained. Of course, the expert operated the damper and hauled it down as far as possible. As all of the boilers were on one steam main, the partial closing of the damper in one case did not materially affect the total output of steam. After the test was finished and due allowances made, a standard of 11.5 per cent. of CO_2 was established. Sampling bottles were put on all of the boilers and then commenced the work of living up to that 11.5 per cent.

The firemen were instructed to run with partly closed dampers; this they did and the result was that the steam pressure came down. Of course, the men then opened up on the dampers and when the samples were analyzed at the end of the first day there were all sorts of CO_2 averages ranging from 6 to 10 per cent. These conditions prevailed for a few days and then the men tumbled; they found that with the dampers closed and the blowers going full speed they could obtain a large percentage of CO_2. Consequently, they would fill the sampling bottles in a few minutes and then shut them off entirely; of course, this could only be done on the night watch when there were no bosses watching.

The result was that the night watch was praised and the day watch "got the dickens." After that the day watch would wait until noon and make their samples when the bosses went to lunch and there was a let-up on the steam.

On the whole, the office received satisfactory legitimate CO_2 samples. These came to average 12 and often times 14 per cent. This went on for a few weeks

when things began to happen; tubes commenced to drop and doors and furnaces burned out.

I then did a little experimenting on the oil-burning boilers, of which there are four in this plant. I found that by setting the damper so that smoke could be faintly seen coming from the stack, keeping the flame some 6 in. below the bottom tubes and by opening the sight shutters just far enough to look into the furnace I could obtain a percentage of CO_2 as high as 13.2. Also, after several trials, I found that by reducing the air space around the burners where they entered the furnace, better results were produced as I was then able to get an average of 14 per cent.

A. POHLMAN.

Brooklyn, N. Y.

Feed Water Regulators

In the Jan. 2 issue, Mr. Rockwell quotes the question, "What is the use of keeping the water level constant?" If the water level is not constant, how can a fireman regulate the fires to keep the steam pressure constant?

This in most plants is more or less essential, and, although I am not as familiar with the subject as others, I should think that if the water level varies much a plant would require a percentage of surplus boiler capacity equal to the percentage of variation of water level plus the percentage of load variation, in order to maintain uniform steam pressure.

W. R. SMITH.

Alton, Ill.

In further reference to the above subject, I wish to say that a regulator which does not permit of a constantly graduated feed to the boiler in proportion to the amount of evaporation is more detrimental to economical operation than hand feeding. There is considerable saving attached to the use of an arrangement which will perform the functions as stated above, while there is a proportionate loss where the controlling device affords an intermittent feed. This point was very forcibly brought out in a previous article on this subject, and it was not my purpose to oppose or in any way contradict any statements which have preceded mine.

When I referred to a good regulator in my letter in the Jan. 30 number, I had reference to one which does not necessitate the valve being slotted in order to allow enough water to pass the valve during the closed period to keep the temperature of the water from the heater as nearly uniform as possible. There is a regulator which does this automatically and I believe that if engineers will see all the regulators before purchasing they will be well rewarded for their trouble. I do not wish to go on record, however, as recommending any regulator which does not permit of a graduated feed.

C. L. JOHNSON.

Newark, N. J.

A Collegian's Come Back

In reading over some of the back numbers of POWER, I came across (in the number of Feb. 14, 1911, page 269) a filler relating the troubles of a certain college graduate in figuring out the increase of power required to double the output of a fan in his uncle's dry kiln. He made the mistake of assuming that to double the output of the fan he would have to cube the power input, thereby increasing the input from 5 to 125 hp. He then had to suffer the humiliation of being corrected by "Jim," who said that all they would need was another 5-hp. fan.

This article was evidently intended to satirize the lack of "horse sense" of the average college graduate. But is it not possible that, in his eagerness, the author overstepped himself?

According to the figuring credited to "Bill," if the original horsepower had been one, then the new horsepower required would be one ($1^3 = 1$). Evidently there is something wrong.

The theory the college graduate would naturally have in mind is not as stated in the article; he would argue that as the input varies as the cube of the output, to double the output would require an input of

$$5 \times 2^3 = 40 \ hp.$$

As the article is evidently fictitious, the verdict of too much theory which the author intended to pronounce on the college graduate, finally reverts back on the author himself in the shape of incorrect theory.

After all, is it not fairer to assume that the liability to carelessness and that type of mistake depends on the man himself, and not on the fact that he is a college graduate?

H. E. RALPH.

Ithaca, N. Y.

Some Load

Answering H. T. Fryant's inquiry in the Jan. 9 issue as to the amount of loss in an 18x42-in. engine taking steam full stroke, I will say that I have made some approximate calculations which plainly show up the losses. The most economical cutoff for a simple Corliss engine, all things considered, is about one-quarter stroke.

According to Mariotte's law, relating to expansion of gases, the mean effective pressure would be 0.597 times the initial pressure. Allowing about 4 per cent. for clearance and compression and a card factor of 0.90, there is had for the final mean effective pressure, as shown by the indicator,

$$0.597 \times 0.96 \times 0.90 = 0.52$$

of the initial pressure, with one-quarter cutoff.

From Mr. Fryant's diagram there is found a mean effective pressure of about 0.71 of the initial pressure for four-quarters cutoff; hence, the ratio of work per pound of steam in each case is

$$\frac{0.52}{0.71} \times 4 = 2.93$$

that is, it takes about three times as much steam per foot-pound of useful work for the longer cutoff.

I say about, because the figure 0.52 for one-quarter cutoff is not strictly correct, as the ratio

$$\frac{M.e.p.}{Initial\ press.}$$

should be figured from absolute instead of atmospheric pressure as I have done because the scale of the indicator spring is not given.

B. S. NELSON.

Bayonne, N. J.

Mr. Fryant's indicator diagrams on page 64 of the Jan. 9 issue certainly indicate some load, and I imagine the owner pays some coal bills.

The information is very meager so that only a general idea of the saving in steam that can be effected by running the engine with proper cutoff can be stated. If the cutoff were 25 per cent., the amount of power would be about 60 per cent. of what is obtained with 100 per cent. cutoff, but at the same time the steam consumption would be decreased to about 25 per cent., depending on the clearance.

Thus, approximately the same power could be obtained with only 40 per cent. of the present steam consumption. This figure would vary, of course, depending on the load on the engine and the setting of the governor, but there is no doubt that a very large saving could be obtained.

W. L. DURAND.

Brooklyn, N. Y.

Using the Firm's Stationery

It is a most natural thing for the purchasing agent or the superintendent to "feel sore" at an engineer who goes over his head and orders some samples of oil, etc., to be tried out. A case in point is J. C. Hawkins' experience as related in the Jan. 16 issue; it was because of the fact that the engineer incurred the displeasure of the superintendent, that the oil was not ordered.

Would it not have been far better for the engineer to make a suggestion to either of the aforementioned to write officially for a sample instead of going

ahead himself and writing on the firm's stationery?

We must appreciate that a "live" concern—taking the oil and grease company as an example—is in business to "get the business," and when an engineer writes for samples, and later sends in a testimonial as to the worth of the material, the oil company will use this to get that firm's business. It is not a question with it whether the engineer took the sample merely for personal experiments; it is purely a case of "here is a prospective user who has found our grease good for his service, and now it is up to us to get his business." For this reason, the firm was followed up carefully with a request for the business and the engineer's recommendation of their product was sent with the request.

On the whole, everybody employed by a concern should not be allowed to use the firm's stationery as a matter of principle. There is a head to each department, and it would have to be a mighty good purchasing agent who could not take suggestions from the operating engineer or superintendent to get a sample of an article, the person recommending it believing that such requested material was for the benefit of the concern.

The concern itself ought to make a specialty of following up these requests, for, when an engineer takes the time to look up trade papers and advertisements to keep abreast of improvements, he shows, to my mind, an interest in his job.

NATHAN OWITZ.

New York City.

Sand for Hot Boxes

The discussion following the editorial on the use of sand in hot bearings has proved both interesting and instructive. It has served clearly to establish the facts that sand undoubtedly has been used to advantage in heated bearings and that the engineers of today are afraid to use it, though frequently using the finer grits like grindstone dust and Sapolio. However, no attempt has been made to analyze the action of sand to show the conditions under which it may be safely used and what conditions would render its use disastrous.

The instances noted where it has been used to advantage have all been in connection with marine work, mostly propeller-shaft bearings. These, of course, are large shafts running at low speed and are more than likely to have large clearance and some chucking motion from the direct action of the engine. If sand and oil are admitted to such a bearing, the sand will be instantly crushed to a powder and each grain will form for a moment a little oil stone, smoothing and polishing the shaft where it touches, and then be carried away by the oil. This process soon accomplishes the very satisfactory grinding of the shaft, when, of course, the heat abates.

The condition for successful use, then, is that each grain of sand shall be instantly crushed to powder as soon as it enters the bearing, when it forms a patch of grinding surface.

In a light, high-speed bearing, where the sand grains might not be crushed, some of them would likely get jammed in such a position as to present a cutting edge to the shaft. This would not only score the shaft, but would add small steel chips to further aggravate the trouble. Doubtless sand has its place in the care of large, loose bearings, but the engineer operating in the modern power plant does well to be distrustful of it.

G. M. WESLEY.

LaFayette, Ind.

On two occasions I have used sand for large bearings, and on many for small ones. On a large passenger steamer, trading between Glasgow and New York, the crankshaft was lined with new white metal. On the first trip after the overhaul, the two after-bearings gave a lot of trouble with heating, so we broke up an old grindstone and fed the dust into these bearings, running at low speed during the operation. The results were most satisfactory.

The other large job was on a 2000-hp. horizontal compound engine. One of the main bearings fired and the metal ran before the engine was stopped. The shaft was badly scored, owing to the weight coming on the narrow brass strips which held the white metal from flowing. We filed up the shaft and fitted in the spare set of bearings. The new bearings ran very hot and so we fed in grindstone dust and ran the engine at low speed. This was kept up all night, and the bearings were repeatedly washed out with the hose. At 7 a.m. we ran the engine at full speed and under full load, and it never gave any further trouble.

There is no necessity to use sand for every hot box, but there are cases where drastic remedies have to be adopted, and in such cases I would not hesitate to sand a bearing in order to bring it back to its normal condition.

W. DICK MACLEAN.

Paisley, Scotland.

Home Made Water Heater

Surely Hugh S. Russell must have considerable trouble with his home-made water heater as described in the Dec. 26 issue. If the water pressure is 40 lb., the steam pressure 45 lb., and there is an unlimited supply of steam furnished to the heater, it is certain that nothing but steam will be delivered at the water outlets. He says that it works satisfactorily at all times. This is hard to understand. Further, I would not imagine this heater to be a pleasant thing to have around for the steam entering directly into the cold water must make a very disagreeable noise.

In large, uptodate heaters the water-temperature regulating valve sometimes gets out of order, allowing the water to attain a temperature above the boiling point, corresponding to a steam pressure of 20 lb. When this happens, the water at the outlets will instantly flash into steam as soon as it reaches the open air. If the water reaches a higher temperature it will flash a little quicker, and this is what will probably happen to Mr. Russel's heater.

If a thermostatic valve were attached to the hot-water tank to automatically close off the steam supply when the water reached a temperature of, say, 200, or even 212, deg. F., the heater would be satisfactory.

Where I am employed there are water heaters delivering water 600 and 700 ft. away from the heaters and it is not satisfactory if the water attains a greater temperature than 212 deg.

JOHN THORN.

Toronto, Ont.

A Vacuum Puzzle

In the issue of Jan. 2, entitled "A Vacuum Puzzle," is an article by Leighton Johnson.

Mr. Johnson neglects to state how the high-speed engine was connected in service with the Corliss engine, and also the location of the vacuum gage. It might have been that the vacuum at the condenser was as high and possibly even higher than before the high-speed engine exhausted into it, and with the vacuum gage located at or near the small engine, or even at or near the large engine, the gage could show but 24 or 25 in. This, however, would not explain the rise in speed of the Corliss engine. It would seem, therefore, that the governor was not sensitive enough and could not control the speed of the engine.

It may, however, be that if the high-speed engine were connected to the same line shaft as the big engine, that the relative speeds would be such that the high-speed engine, having a slightly higher belt speed than the Corliss, would tend to speed up the line shafting. It is also quite possible that as some high-speed engines are large steam eaters, the excess steam used by this engine, carrying an excessive overload due to its higher speed and thus taking a larger proportion of the load than it was supposed to, is responsible for both the increased speed of the Corliss engine and the decreased vacuum at the condenser.

HENRY D. JACKSON.

Boston, Mass.

Inquiries of General Interest

Questions are not answered unless accompanied by the name and address of the inquirer. This page is for you when stuck—use it

Refrigeration for Cold Storage

What is the refrigeration required for a cold-storage room 50 ft. long, 75 ft. wide and 10 ft. high, if 40,000 lb. of pork are daily placed in the room to be chilled from 95 to 35 deg. F. if the atmospheric temperature is 80 deg. F.?

F. M. H.

The determination of refrigeration required in a given case may be calculated by allowing first for the refrigeration necessary to keep the storage at a certain given temperature in consequence of the radiation through the walls. Second, for the refrigeration required to cool the articles from the temperature at which they enter the storage room down to its temperature. The rule to find the refrigeration to replace the cold lost by transmission through the walls is:

The quotient of the product of the difference of the outside temperature and the temperature required in the cold room and the number of square feet of surface of the ceiling, side walls and floors and the factor 3, for average construction and conditions, divided by 284,000.

The factor changes according to the character and construction of the walls, it being 5.5 B.t.u. for a brick wall 4½ in. thick to 2.2 for one 36 in. thick; from 6.2 B.t.u. for a stone wall 6 in. thick to 4.1 for one 36 in. thick. The surface of the walls is

$$2 \times 50 \times 10 + 2 \times 75 \times 10 = 2{,}500 \text{ sq.ft.}$$

The surface of the ceiling and floor is

$$2 \times 50 \times 75 = 7{,}500$$

$$10{,}000 \text{ sq.ft.}$$

Substituting figures for the rule, it would be expressed thus:

$$\frac{10{,}000 \times 3\,(80° - 35°)}{284{,}000} = 4.7 \textit{ tons}$$

The additional refrigeration required to chill the meat, assuming its specific heat to be 0.8, is expressed in the following formula:

$$\frac{40{,}000 \times (95° - 35°)}{355{,}000} = 6.76 \textit{ tons}$$

The total refrigeration required is

$$4.7 + 6.76 = 11.46 \textit{ tons}$$

Steam Engine Efficiency

What is the efficiency of a noncondensing engine which on a test took 26 lb. of steam per horsepower-hour, with an initial pressure of 115 lb., the steam containing 2 per cent. moisture and the temperature of the feed water being 210 deg. F.?

G. D. K.

The heat of evaporation of steam at 115 lb., or, say, 130 lb. absolute, is 872.3 B.t.u. Since the quality of the steam is 98 per cent. or only 0.98 is in the form of steam, it will take

$$872.3 \times 0.98 = 854.85 \textit{ B.t.u.}$$

to evaporate this quantity. The heat of the liquid at 130 lb. is 318.6 B.t.u. Therefore, the heat carried to the cylinder with each pound of vapor is

$$854.85 + 318.6 = 1173.45$$

the water at 32 deg. being considered as a base. The temperature of the feed water is 210 deg. F., but the heat of the exhaust is capable of heating the feed water to 212 deg.

$$212 - 32 = 180 \textit{ B.t.u.}$$

The heat supplied to the engine per pound of steam is therefore

$$1173.45 - 180 = 993.45 \textit{ B.t.u.}$$

and 26 lb. per hour will bring to the engine

$$26 \times 993.45 = 25{,}829.70 \textit{ B.t.u.}$$

A horsepower-hour is

$$33{,}000 \times 60 = 1{,}980{,}000 \textit{ ft.-lb.}$$

or

$$1{,}980{,}000 \div 778 = 2545 \textit{ B.t.u. per hour.}$$

To produce the equivalent of 2545 B.t.u. of work, 25,829.7 B.t.u. were used. The thermal efficiency is

$$\frac{\textit{B.t.u. of 1 hp.}}{\textit{B.t.u. used by engine}} = \frac{2545}{25{,}829.7} = 9.8\%$$

Factor of Safety

What is meant by the factor of safety?

G. R. R.

The factor of safety is the ratio of the strength of the material to the maximum load put on it; that is, if the factor of safety of a boiler is 5, the maximum load allowed is ⅕ the ultimate strength of the weakest part.

Soldering Cast Iron

Can cast iron be soldered?

L. G. M.

Yes; but it is a difficult job. The following method will give good results: Clean the parts well with emery or a file. Coat the parts to be joined with a soldering flux having a high proportion of zinc and bind them together tightly with iron wire. Then pack the edges of the joint with a thick paste of borax and water. Put the assembled pieces into a clear charcoal fire and as soon as they become dark cherry red, add finely divided solder and more borax. When the solder has run well through the joint, remove the piece from the fire and let the joint cool slowly. Do not clean off the surplus solder until the piece is quite cold.

Reversing an Engine

In bringing a large reversing engine to a standstill, is it good practice to reverse the engine with the throttle open to hasten the stop?

B. F. G.

This should not be done except in extreme cases. Shut the throttle and then throw over the reversing lever, utilizing the compression in the cylinder to facilitate the stopping.

Shunt and Compound Wound Generators in Parallel

What would happen if a compound- and a shunt-wound generator were run in parallel?

A. L.

Nothing very harmful; they would not divide the load proportionally.

Comparative Efficiency of Boilers

What factors should be considered in gaging the relative merits of water-tube and return-tubular boilers? With good water, what should be their comparative efficiency?

B. D. H.

Equally well proportioned to the work, set and operated, there should be no difference in their efficiency; one will evaporate as much water per pound of coal as the other under equally favorable conditions. The advantage of the water-tube boiler is the possibility of getting larger capacity into a single unit, and immunity from disastrous explosions.

Brake Horsepower

What is meant by brake horsepower?

N. P.

Brake horsepower is the power being delivered to the shaft. It differs somewhat from the power being produced in the cylinder because of the friction of the engine. It is the indicated horsepower less the frictional power of the engine itself.

French Boiler and Steam Receiver Accidents

The boiler catastrophe statistics of other countries are always instructive and salutary, but they are not altogether flattering to national vanity as may be seen in the following figures taken from the bulletin of the French labor office:

In 1909 there were reported 29 accidents occasioned by the use of steam, five of them causing only damage to inanimate objects or slight personal injuries. From the 24 others there resulted 15 deaths and 26 injured seriously enough to occasion 20 days' incapacity for work. There were 28 accidents and 13 killed and 41 injured in 1908.

If the number of accidents and the number of victims are compared with that of apparatus in use, the following averages are obtained for each 10,000 pieces of apparatus named for the last two years:

	Accidents		Killed		Injured	
	1909	1908	1909	1908	1909	1908
Steam boilers	1.9	1.9	1.0	1.3	2.1	0.8
Receivers....	1.7	1.2	0.9	0.3	0.6	0.3

It will be noticed that the receiver accidents in 1909 were more numerous and disastrous than in 1908.

In the table following, during the period 1890 to 1909, it is shown that the frequency of accidents did not greatly vary until 1899; thence until 1904 there was a decrease, after which there was a further decrease from 1905 to 1909:

ACCIDENTS REPORTED TO EACH 10,000 PIECES OF APP RATUS

	Accidents	Killed	Injured
1890–94	3.0	1.8	1.6
1895–99	3.2	1.9	2.0
1900–04	2.3	1.5	2.2
1905–09	1.8	1.2	1.4

Air Reservoirs Explode

The air reservoirs in the Charlotte (N. C.) Electric Ry. Co.'s power plant exploded about 11 o'clock p.m. on Feb. 2 and nearly wrecked the building. No one was hurt. The reservoirs, located in the engine-room basement, were used for starting the gas engines.

The head of one of the tanks, about 9 ft. long and 5 ft. in diameter, was blown out and the cement floor above the basement was torn up for 10 or 15 ft.; the windows were blown out, and the water pipes on No. 1 engine were stripped.

Only a short time ago one of the boilers in the producer plant exploded and killed a fireman.

Power Plant Wrecked

On Jan. 30, the power plant of the Consolidated Ice & Power Co., at Valdosta, Ga., was wrecked. A car of coal being pushed up on the coal chute by a switch engine caught a guy wire, pulling down two smokestacks, two poles and completely demolishing the wire system. As a result, the city was left in darkness and the street-car service at a standstill. Nobody was hurt in the accident, but the plant presented a scene of wreckage, with one of the switchboards out of commission along with wires and poles.

Locomotive Boiler Bursts

By the bursting of the boiler of a freight engine on the Lehigh Valley R.R. near Somerville, N. J., on Feb. 4, the engine was thrown across the track of an approaching freight train and both engines were completely wrecked. The rear brakeman was killed and an engineer and a fireman injured. Four freight cars were derailed.

Engineers of "Diamond" Suspended

Following evidence given at the coroner's inquest and the investigation of the United States inspectors of steam vessels into the explosion of the boilers on the towboat "Diamond" in the Ohio River near Pittsburg, Dec. 3, Chief Engineer Charles Martin and Second Engineer Frank Price, of the boat's crew, were suspended for a period of six months. Five men lost their lives in the explosion. The body of Captain Edward Swaney was never found. According to Inspectors Isaac B. Williams and Charles G. Thomas, the engineers may get another suspension of their licenses when they make new applications.

Rhode Island Coal Co. in Receiver's Hands

John T. Burnett, of Southboro, Mass., was on Feb. 1 appointed receiver for the Rhode Island Coal Co. under bonds of $50,000 by Judge Dodge in the United States District Court, at the request of Henry M. Whitney, the president. Its coal mine is located at Portsmouth, R. I.

The company, which owes $704,337, is organized under the laws of Maine with a capital stock of $5,000,000. Shortly after it came onto the market the stock sold for $12 a share, but recently it fell below a dollar, and sold on the curb for 30 cents.

President Whitney is the principal creditor, having loaned $500,000 on notes. There is a mortgage on the property amounting to $120,000. Notes outstanding amount to $666,902.

OBITUARY

George H. Clark died at his residence in Brooklyn, N. Y., on Feb. 5. He was in his eighty-third year, and for over half a century had been the managing owner of the Salamander Grate Bar Co., New York City.

PERSONAL

J. G. Rossman, general manager of the Civic Light & Power Plant, at Winnipeg, Man., has resigned this $6000 position. It is said that Mr. Rossman objected to the interference of the Board of Control in his department.

Joseph F. Carney has been appointed chief engineer of the plant in the Hotel McAlpin, New York City, which, when completed, will be the largest hotel in the world. Mr. Carney is a past president of the National Association of Stationary Engineers and for years has been chief engineer at Sherry's.

E. P. Roberts, president of the Cleveland Engineering Society, has been appointed smoke inspector of that city by Mayor Baker. Mr. Roberts says that the department under his charge will not bring about abruptly the changes desired, and that educational work will be an important feature of the work. He favors the establishment of a smoke-observation station on the top of a skyscraper, and this plan may be worked out later in connection with the general reorganization scheme. The salary is $3600 a year.

Charles C. Moore, president of the Panama-Pacific Exposition of 1915, in his recent visit to New York City, said that everything points to a most successful exposition. Twenty states have already manifested their willingness to participate, and diplomats at Washington are deeply interested and are likely to recommend that their respective countries be represented. Mr. Moore is anxious that the opening of the exposition be simultaneous with that of the canal and also that every foreign land may participate and thus make the affair a really great universal exposition.

Charles H. Garlick, past president of the National Association of Stationary Engineers and prominently identified in industrial enterprises in western Pennsylvania, on Feb. 2 was appointed inspector of steam engines and steam boilers for Allegheny County by Governor John K. Tener. He succeeds J. J. Kelly, who has held the position about four years. Mr. Garlick was born in Ohio 50 years ago but has resided in Pittsburg nearly all his life. For more than a quarter of a century he has been actively engaged as a mechanical engineer, and for the last 15 years as consulting engineer for the Atlantic Refining Co. Previously he was employed as chief engineer of the Howard Plate Glass Co. and the Pittsburg Plate Glass Co. He is a member of the Engineers Society of Western Pennsylvania, a member of the Ohio Society of Electrical and Mechanical Engineers and past chief of the Universal Council of Craftsmen and Engineers.

Moments with the Ad. Editor

Once upon a time we wrote a little screed on "Advertising" and printed it among the advertising pages.

It began something like this:

"Back of every advertisement in this paper is a story—the gripping story of an idea that took shape in the mind of some man and finally evolved into the finished product you see advertised."

Of course there was more than that to it, but in the opening paragraph we tried to express the *romance* of manufacturing.

The average hard headed business man and the equally hard headed buyer will scoff at the thought of romance connected with the making of machinery. Those same men will shed tears over the woes of the lady in black at the drama and madly applaud when the hero yanks her from in front of the onrushing papier-mâché locomotive.

All of us are so prone to overlook the real and thrill at the make-believe.

The histories of great inventions, dramatized, would make great plays.

Bell's struggle and final success with the telephone is a glittering example.

The lesser inventions have their history of romance but the limelight has been focused elsewhere and they have passed unnoticed.

We might take any single machine or device in the advertising pages of this paper and just the bare history of it, written, would make good reading.

We remember that James L. Robertson, Sr., wrote the history of Eureka Packing and made of it a series of the most interesting sort of advertisements.

We believe that others might profit by this example and that readers will be entertained and the advertisers profited.

But that, as Kipling says, is another story.

This is the point we want to draw from the lesson of the older inventions:

Their great struggle was to command the services of capital and the attention of the public.

And on these rocks many inventors of highly commendable things wrecked their hopes.

And many commendable devices were lost to a public which might have benefited by them.

But the situation has changed and the credit for the change belongs to *advertising*.

Just that, advertising. Bless you, advertising is nearly as old as mankind; we're talking about the modern, scientific application of this economic power.

In the old days, capital fought shy of new inventions because capital feared the uncertainties and slow growth of public confidence.

Advertising meant nothing to capital because advertising in those days was not understood nor appreciated.

Today, capital is chiefly concerned with the merits of the invention and the possible demand for it.

It knows that by the proper application of the great creative power, advertising, it can produce business almost instantly; certainly instantaneously compared with the stage-coach method of 25 years ago.

So capital creeps out from under the bed and works up its circulation by some healthy exercise.

Meritorious inventions are marketed; the world is told of them in short order and the world, buying, profits because the new device saves time or money or labor.

Therefore, advertising, like any good contract, works both ways, benefits both parties.

Advertising from your point of view is *education*.

You are no longer kept in ignorance of new and improved devices for accomplishing better results in your work—every week they are spread before you in this paper.

Whether they appeal to your judgment or meet your requirements are questions for you to decide.

But you can't learn of them through a lowered curtain.

And taking an occasional peek behind the scenes won't give you more than a smattering of the exhibition.

Make a point of reading the advertisements *weekly*, not *weakly*.

Mainly because it will *pay* you.

NEW EQUIPMENT

Coggan, Iowa, will install a municipal electric-light plant.

F. C. Eckels will install an electric-light plant at Conneautville, Penn.

P. A. Yohe will construct an electric-light and power plant at Morning Sun, Iowa.

George T. Gibson, Des Moines, Iowa, will install a power plant at Altoona, Iowa.

The Preston Shaffer Milling Co., Weston, Ore., will rebuild its electric-light plant.

Wellsville, Ohio, is considering the installation of a municipal electric-light plant.

Middletown, Ky., is contemplating the installation of a municipal electric-light plant.

Mildred, Kan., is contemplating the installation of a municipal electric-light plant.

Hubbard, Ohio, has voted bonds of $30,000 for constructing a water-works system.

The Ashland Oil Mill & Fertilizer Co., Ashland, Ala., will install an electric-light plant.

W. B. Sorelle, of San Antonio, Tex., will install an electric-light plant in Hondo, Tex.

Lebanon, Ohio, will make considerable improvements to the municipal electric-light plant.

The Merchants' Co., Atlanta, Ga., will construct a power plant. Estimated cost, $30,000.

The Browder Ice Cream Co., 918 North Senate Ave., Indianapolis, Ind., will install a boiler.

Vicksburg, Miss., will construct a new water-works plant. C. R. Twiss is city engineer.

The Hollenden Hotel, Cleveland, Ohio, will erect a new power plant in its proposed addition.

Cumberland, Md., will install a municipal electric-light plant. George G. Young is mayor.

The Big Five Coal Co., St. Clairsville, Ohio, will buy new power plant and electrical equipment.

Newcastle, Ind., is considering improvements to the municipal water and electric-light plant.

Chamberlain, S. D., is considering improvements to its water-works system. Estimated cost, $20,000.

The C. G. Garragus Machine Co., Bristol, Conn., will build a boiler house in connection with its plant.

The plant of the Elizabeth City Electric Light Co., Elizabeth City, N. C., was recently destroyed by fire.

Lynn, Ind., is considering the installation of a power plant to supply electricity for the street-lighting system.

Calgary, Alta., is considering improvements and extensions to its municipal electric-light plant to cost about $368,000.

The mayor of Columbia, S. C., will receive bids until Feb. 14, for improving the municipal water-power pumping plant.

Osage, Kan., will install a 100-hp. oil engine in the municipal electric-light plant. George Dawson is manager of plant.

Toledo, Ohio, has voted a bond issue of $150,000 for a new water-works system. George W. Tonson is city engineer.

The Smithville Electric Light Co., Smithville, Mo., will install an ice plant. Estimated cost, $5000. A. C. Morton is secretary.

The local electric-light plant at Verndale, Minn., was recently destroyed by fire and will be rebuilt. H. M. Hicks is interested.

The Wayne Power Co. will construct an electric-light plant at Cohocton, N. Y. G. R. Mills, Sodus, N. Y., is interested.

Senecaville, Ohio, will soon receive bids for the construction of a water-works system to cost $40,000. J. W. Dilly is mayor.

The Light & Development Co. will improve the plant, recently purchased, at Poplar Bluff, Mo. H. Wurdack, St. Louis, is president.

The Cadillac Sand & Gravel, Toledo, Ohio, is contemplating the purchase of a power plant and equipment. F. F. Ferge is interested.

Fargo, N. D., has voted a bond issue of $10,000 for improvements to the municipal electric-light plant. Frank L. Anders is city engineer.

The New York, New Haven & Hartford R.R. Co. is considering the construction of an addition to its power plant at Cos Cob, Conn.

The Port Arthur Water Co., Port Arthur, Tex., will install a turbine generator of 1000-kw. capacity, and a battery of boilers for turbine.

J. W. Schwartz, of Colorado Springs, Colo., has the contract for constructing a water-works system at Fort Logan, Colo. Estimated cost, $12,090.

The Wheeling Traction Co. is contemplating improvements to its power plant at Wheeling, W. Va. George O. Nagle, Wheeling, is general manager.

Holland, Mich., will install a 1000-kw. steam turbine and a 300-hp. boiler in the municipal electric-light plant. R. B. Champion is manager of the plant.

The Sumter Lighting Co., Sumter, S. C., will expend $25,000 for improvements to its electric-light plant. A 750-hp. turbine engine will be installed.

Edmonton, Alta., will make several improvements to its municipal electric-light plant. Estimated cost, $210,000. J. C. Huffman is superintendent of plant.

The Crane Falls Power & Irrigation Co., Boise, Idaho, will receive bids until Mar. 4, for three hydraulic turbines, 3000-hp. each, two exciters, 200-hp. each.

The Central Georgia Power Co. is considering the construction of a substation at Atlanta, Ga. Estimated cost, $85,000. W. J. Masee, Macon, is president.

The Pacific Light & Power Co., Los Angeles, Calif., will construct an addition to its power plant on Central Ave. A. C. Balch, Los Angeles, is general manager.

The Nordberg Manufacturing Co., of Milwaukee, Wis., has the contract for an 8,000,000-gal. pump for the water-works system at Sheboygan, Wis. Estimated cost, $34,000.

Paonia, Colo., will install a 100-kw. alternating-current generator and engine in the municipal electric-light plant. W. R. Jewell is superintendent of the plant.

The Union Utilities Co., Morgantown, W. Va., is considering the installation of a 2000-kw. high-pressure turbine generator set. C. E. Nigh is engineer of power station.

The Weymouth Light & Power Co., East Weymouth, Mass., is considering the installation of a 1000-hp. steam turbine and two boilers. Milton A. Carter, East Weymouth, is manager.

The Central Minnesota Power & Milling Co., Sauk Center, Minn., will install a 100-kw. alternating-current, three-phase, 60-cycle generator. S. T. Merryman is secretary and manager.

The construction of a power plant at Sedro-Woolley, Wash., to supply power for its railway, is contemplated by the Whatcom County Ry. & Light Co. L. R. Coffin, Bellingham, is manager.

The Cleveland, Southwestern & Columbus Ry. Co. will purchase new equipment for its power house at Elyria, Ohio. Estimated cost, $100,000. E. F. Schneider, Cleveland, is general manager.

The Louisville Ry. Co. will construct a power plant on High St., Louisville, Ky. Estimated cost, $300,000. T. J. Minary, 316 West Jefferson St., Louisville, is president and general manager.

The United Electric & Improvement Co., New York, N. Y., will construct a power house at Two Hundred and First St. and Broadway. James G. Swallow, 4 Irving Pl., New York, is superintendent.

The Liberal Light, Ice & Power Co., Liberal, Kan., is considering the installation of a 200-hp. oil engine and a 150-kw., 60-cycle, three-phase, 2300-volt generator. H. W. Magruder is president and manager.

NEW CATALOGS

Washington Pipe & Foundry Co., Tacoma, Wash. Catalog. Wooden stave water pipe. Illustrated, 94 pages, 6x9 in.

Ingersoll-Rand Co., 11 Broadway, New York. Form No. 4204. "Arc Valve" tappet rock drills. Illustrated, 16 pages, 6x9 in.

The Armstrong Manufacturing Co., Bridgeport, Conn. Catalog. Pipe-threading machines. Illustrated, 46 pages, 6x9 in.

The Engineers' Appliance Co., Cleveland, Ohio. Catalog No. 1. Hydromatic water-control valve. Illustrated, 3½x7½ in.

Electric Weighing Co., 180 Thirteenth Ave., New York. Pamphlet. Electric weigher for ore, coal, cement, etc. Illustrated, 16 pages, 6x9 in.

Standard Regulator Co., 90 West St., New York. Catalog D. Standard system of automatic temperature control. Illustrated, 14 pages. 4x9 in.

Ingersoll-Rand Co., 11 Broadway, New York. Form No. 3211. Imperial Type X, duplex steam-driven compressors. Illustrated, 20 pages, 6x9 in.

The Veeder Manufacturing Co., Hartford, Conn. Catalog. Tachometers, revolution counters, tachodometers, etc. Illustrated, 86 pages, 5x7 in.

United States Indestructible Gasket Co., 50 Church St., New York. Leaflets. Grooved-metal packing, gaskets, washers, disks, etc. Illustrated.

Best Manufacturing Co., Pittsburg, Penn. Catalog No. 103. Valves, fittings, flanges, pipe and pipe bends, separators, etc. Illustrated, 396 pages, 4x6½ in.

Taylor Iron & Steel Co., High Bridge, N. J. Bulletin No. 100-B. Tisco manganese steel gears and pinions. Illustrated, 6x9 in. Bulletin No. 113. Tisco manganese steel chains, sprockets and spiral conveyors. Illustrated, 6x9 in.

The Goulds Mfg. Co., Seneca Falls, N. Y. Bulletin No. 104. Double-acting triplex piston pumps. Illustrated, 12 pages, 8x10 in. Bulletin No. 106. Vacuum and stuff pumps. Illustrated, 16 pages, 8x10 in. Bulletin No. 108. Deep well working heads. Illustrated, 12 pages, 8x10 in. Bulletin No. 109. Pumps for special services. Illustrated, 20 pages, 8x10 in.

The Goulds Manufacturing Co., Seneca Falls, N. Y. Bulletin No. 106. Vacuum and stuff pumps. Illustrated, 16 pages, 8x10 in. Bulletin No. 107. Deep well triplex pumps. Illustrated, 12 pages, 8x10 in. Bulletin No. 108. Deep well working heads. Illustrated, 12 pages, 8x10 inches. Bulletin No. 109. Pumps for special service. Illustrated, 20 pages, 8x10 in.

Engineers Wanted

Under this head are published, without charge, advertisements of actual vacancies in power plants for operating engineers and assistant engineers. For the guidance of applicants for advertised positions, the advertisements must contain particulars to show the class of service demanded and the wages paid. Employers who desire to advertise under this head are requested to write for a blank form of application.

HELP WANTED

Advertisements under this head are inserted for 25 cents per line. About five words make a line.

SALESMAN — Thoroughly competent steam specialty salesman; one that can sell high-grade goods. Address "M. M. Co.," Power.

AGENTS for first-class steam specialty in use throughout United States. Address C. S. Wood, 410 S. 15th St., Philadelphia, Penn.

COMPETENT all-round man for erecting Corliss and general engine work, New York City and vicinity; fine position open to right man. Box 589, Power.

THE VULCAN SOOT CLEANER offers an exceptional opportunity for power specialty salesman Address G. L. Simonds & Co., 802 Steinway Bldg., Chicago, Ill.

ASSISTANT ESTIMATOR—Young man familiar with steam, plumbing and refrigeration plans, accurate and quick, capable of taking off quantities and assisting in estimating; state age, experience, salary. Box 590, Power.

PUMPING machinery salesman, a thoroughly competent man to travel principally in southern territory; responses will be considered in confidence if desired. Address, with full information, the John H. McGowan Co., Cincinnati, Ohio.

THOROUGHLY practical mechanical engineer for large manufacturing plant; must be familiar with all classes of machinery, including engines and boilers, and not under thirty years of age. Address, giving age, experience, references and salary expected, "Superintendent," Box 587, Power.

MANUFACTURERS' AGENTS to handle thoroughly guaranteed steam specialties; feed water heaters, steam and oil separators, traps and exhaust pipe heads; not necessary to represent entire line if interested in only part of it; our specialties are well advertised and of good reputation. Box 569, Power.

Situations Wanted

Advertisements under this head are inserted for 25 cents per line. About five words make a line.

PRACTICAL MAN in the mechanical line is open for a position as oil demonstrator. Box 588, Power.

MECHANICAL ENGINEER, first-class steam and electrical, draftsman, etc., wishes position as mechanical superintendent or similar in large concern. Box 591, Power.

ENGINEER or superintendent of small electric power plant; eight years' experience, producer gas, oil or steam; employed at present, but desire change; good reasons; married, sober and capable of rebuilding plant if necessary; state salary. Address Box 581, Power.

MECHANICAL ENGINEER, technical graduate, seven years' experience, boiler, gas engine and steam turbine testing as regards efficiency, power plant operation, design and construction, desires position with consulting or contracting firm, or as executive engineer in manufacturing concern. Box 592, Power.

AS MECHANICAL superintendent with large manufacturing corporation; good executive, broad experience with Curtis steam turbines and reciprocating engines, generators and motors, both alternating current and direct current; uptodate on boiler economy, shop work and machinery in general. Address Box 574, Power.

MISCELLANEOUS

Advertisements under this head are inserted for 25 cents per line. About five words make a line.

PATENTS SECURED—C. L. Parker, Patents, 904 G St., Washington, D. C.

EVERY ENGINEER should be posted regarding the new system of vacuum heating installed without payment of royalty; I have valuable information; write today. C. P. Monash, 1417 W. Jackson Blvd., Chicago, Ill.

FOR SALE

Advertisements under this head are inserted for 25 cents per line. About five words make a line.

FOR SALE—Five Corliss vertical water leg, and sixteen Manning vertical type boilers. J. & P. Coats, Ltd., Pawtucket, R. I.

Engine Builders—High-speed duplex piston reciprocating engine patent for sale; better than turbine; no promoters. C., 45 Park Ave., West Orange, N. J.

8x10 SKINNER ENGINE, direct connected to 30-kilowatt generator, and 8x10 Allfree engine, direct connected to 20-kilowatt generator . Address "Engineer," Box 2, Station A, Cincinnati, Ohio.

LATEST MODEL, heavy duty, 18x42 Brown engine, installed 1904; no reasonable offer refused; this engine was operated by builders' engineer; for sale account of removal; splendid equipment, oil guards, lubricators, metallic packing. Box 575, Power.

SALE of old material at the Naval Academy, Annapolis, Md. There will be sold at the Naval Academy, Annapolis, Md., the old power plant belonging to the Navy and condemned as unfit for use therein, consisting of Corliss and other engines, Lundell dynamos, panels and switches, Worthington and Woodward pumps, Aultman-Taylor boilers, etc. The sale will be for cash to the highest bidder, by sealed proposals to be opened at 12 o'clock noon, February 19, 1912. Schedules containing form of proposals and terms of sale can be obtained upon application to the General Storekeeper, Naval Academy, Annapolis, Md. BEEKMAN WINTHROP, Assistant Secretary of the Navy.

Alphabetical Index to Advertisers

	Page
Albany Lubricating Co.	87
Alberger Heater Co.	67
Alberger Pump Co.	89
Allis-Chalmers Co.	98
Allman Co., W. H.	72
American District Steam Co.	100
American Engine Co.	102
American Engineering Co.	56
American Injector Co.	88
American Mfg. Co.	71
American Metal Hose Co.	100
American Radiator Co.	63
American School of Correspondence	67
American Steam Gauge & Valve Mfg. Co.	46, 47
Anderson Co., V. D.	77
Armstrong Mfg. Co.	72
Armstrong Mfg. Co., The	78
Ashton Valve Co.	82
Austin Separator Co.	76
Babcock & Wilcox Co., The	93
Ball Engine Co.	105
Baragwanath & Son, Wm.	62
Barnes Co., W. F. & John	101
Beggs & Co., James	106
Bignall & Keeler Mfg. Co.	80
Blake & Knowles Steam Pump Works	62
Bogart Gas Power Engineerin Co.	98
Borden Co.	78
Bowser & Co., Inc., S. F.	85
Bristol Co.	4th cover
Bruce-Macbeth Engine Co.	98
Buckeye Engine Co.	104
Buffalo Forge Co.	100
Builders Iron Foundry	67
Burt Mfg. Co., The	14
Cameron Steam Pump Works, A. S.	89
Casey-Hedges Co.	93
Chapman Valve Mfg. Co.	81
Cling-Surface Co.	111
Connersville Blower Co., The	91
Consolidation Coal Co.	11
Cooley & Milligan	78
Cooper Co., C. & G.	98
Crosby Steam Gage & Valve Co.	79
Curtis & Curtis Co., The	81
Dallett Co., Thos. H.	96
Dart Mfg. Co., E. M.	78
Daum Co., A. F.	70
Dean Bros. Steam Pump Works	91
Deane Steam Pump Co.	90
Dearborn Drug & Chemical Works	5
De Laval Steam Turbine Co.	64
Deming Co.	88
Detroit Lubricator Co.	86
Diamond Rubber Co.	80
Dixon Crucible Co., Jos.	86
Durabla Mfg. Co.	66
Elliott Co., 7, 63, 67, 77, 81, 82, 85,	86
Engineers Appliance Co., The	82
Engineer Co.	70
Eureka Packing Co.	57, 60
Fitchburg Steam Engine Co.	102
Flexible Steel Lacing Co.	71
Franklin Oil Filter Co.	86
Garlock Packing Co.	9
General Electric Co.	113
Goulds Mfg. Co.	90
Graver Tank Works, Wm.	96
Green Engineering Co.	73
Greene, Tweed & Co., 59,	4th cover
Griffith & Wedge Co., The	101
Hamler-Eddy Smoke Recorder Co.	95
Hammel Oil Burner Co.	73
Harbison-Walker Refractories Co.	97
Harris Steam Engine Co., W. A.	101
Harrisburg Foundry & Machine Works	102
Harrisburg Mfg. & Boiler Co.	95
Harrison Safety Boiler Works	49
Heine Safety Boiler Co.	94
Hess-Bright Mfg. Co.	112
Hewes & Phillips Iron Wks.	101
Hoffman, Geo. W.	94
Homestead Valve Mfg. Co.	66
Hooven, Owens, Rentschler Co.	101
Hoppes Mfg. Co.	78
Houston, Stanwood & Gamble Co.	104
Howard Iron Works	82
Huyette Co., Inc., Paul B.	84
Independent Ice Co.	92
Ingersoll-Rand Co.	109
International Corr. Schools	55
Jenkins Bros.	51
Johns-Manville Co., H. W.	61
Keeler Co., E.	94
Kellogg Co., M. W.	80
Kennicott Co., The	95
Kerr Turbine Co.	100
Keystone Lubricating Co.	3
Kroeschell Bros. Co.	61
Lagonda Mfg. Co.	3d cover
Laidlaw-Dunn-Gordon Co.	104
Liberty Mfg. Co.	7
Locke Regulator Co.	81, 107
Long Grate Bar Co., The	73
Lunkenheimer Co.	4
Lytton Mfg. Corporation	74
McClave-Brooks Co.	12
McCord Mfg. Co.	69
McGowan Co., The John H.	91
McGraw-Hill Book Co.	108
McIntosh, Seymour & Co.	102
McLeod & Henry Co.	96
Magnolia Metal Co.	107
Manzel Bros. Co.	84
Martin Grate Co.	72
Mason Regulator Co.	82
Mayville Specialty Mfg. Co.	96
Milne Water Tube Boiler Co.	93
Monarch Valve & Mfg. Co.	82
Morehead Mfg. Co.	77

Don't Buy Steam Gauges By The Looks Of The Dial

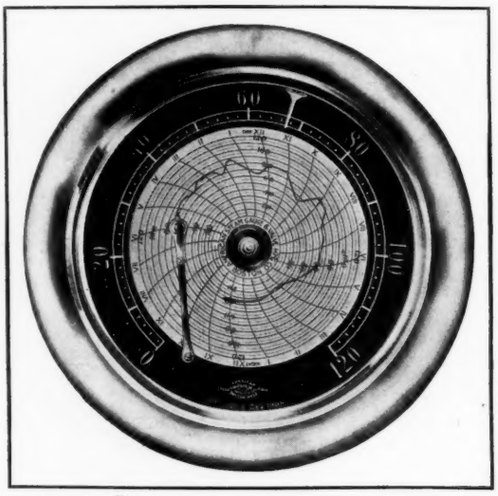
Open them up, compare them, and buy them on the strength of their interior construction, as on this alone depends the service they will give you. If you do this, we'll take our chances on getting our share of the business.

We make steam gauges *right* throughout and don't sell them on the appearance of the dial alone.

We welcome the inspection and comparison of the interior construction of our gauges. The mechanism of American Steam gauges is our special pride. The principles involved have been proved correct by years of perfect service, and the careful workmanship that means the proper execution of those principles is never relaxed.

Every wheel, segment, pinion, etc., is made by experts, on machinery specially built for the purpose, and not even the smallest detail is slighted in any way.

American steam gauges are built to record pressures *exactly*—not approximately—and to record them exactly *always*—not generally.



FREE
Pocket Edition Catalog

We've condensed our general catalog into a Pocket Edition for the purpose of supplying Engineers with a handy book of convenient size for quick reference.

This Pocket Edition will be supplied free to all who write for copies. It is a book worth having.

The coupon, filled in and mailed, tells us where to send *yours*.

SIGN AND MAIL COUPON

American Steam Gauge & Valve Mfg. Co.
Boston, Mass. 2-13-12

Send me your Pocket Edition catalog

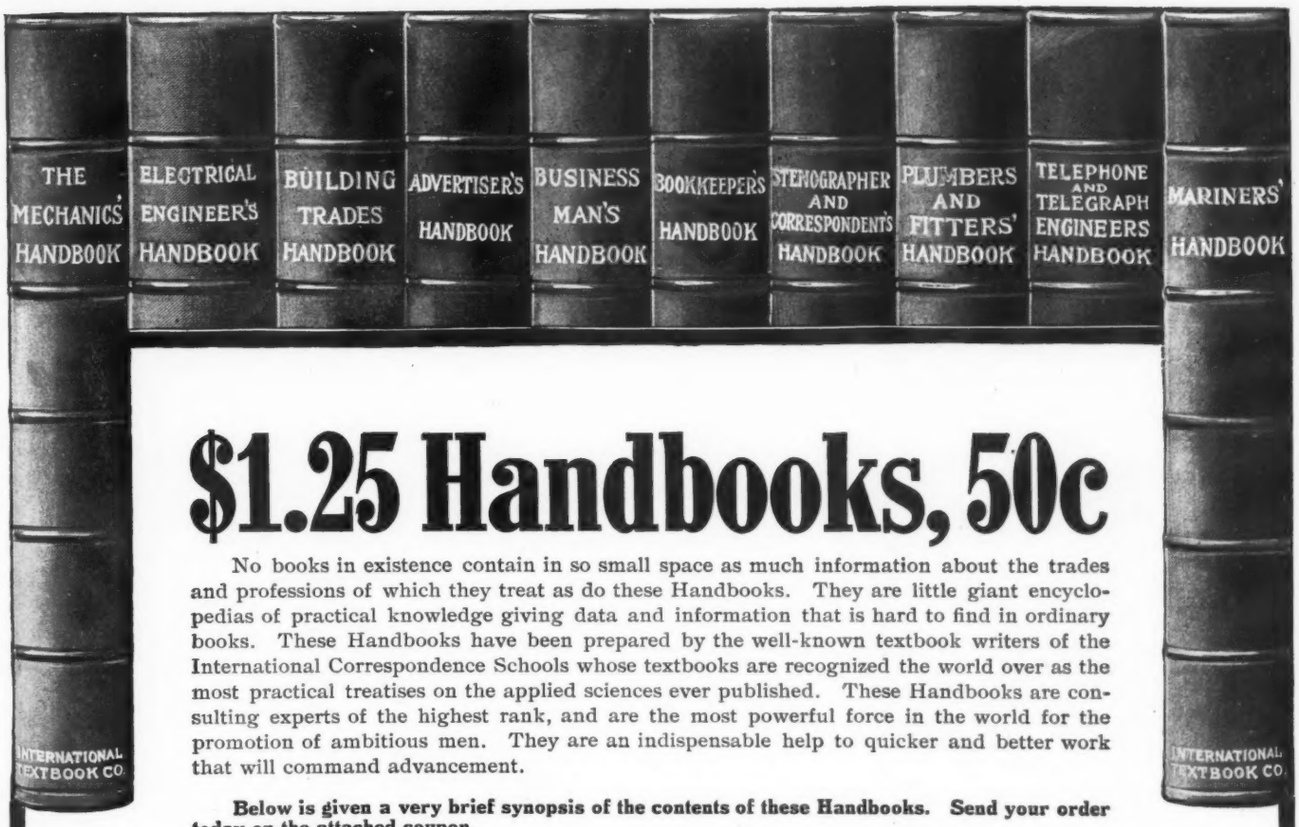
Name. . . . . .

Address. . . . . .

American Steam Gauge & Valve Mfg. Co.
Boston, Mass.

Sales Offices in New York, Chicago, San Francisco, Pittsburg, Atlanta, Montreal

THE BEST HOUSES EVERYWHERE SELL OUR PRODUCTS



$1.25 Handbooks, 50c

No books in existence contain in so small space as much information about the trades and professions of which they treat as do these Handbooks. They are little giant encyclopedias of practical knowledge giving data and information that is hard to find in ordinary books. These Handbooks have been prepared by the well-known textbook writers of the International Correspondence Schools whose textbooks are recognized the world over as the most practical treatises on the applied sciences ever published. These Handbooks are consulting experts of the highest rank, and are the most powerful force in the world for the promotion of ambitious men. They are an indispensable help to quicker and better work that will command advancement.

Below is given a very brief synopsis of the contents of these Handbooks. Send your order today on the attached coupon.

Mechanics'.—Tables; formulas; measurements; belting; mechanical powers; hydromechanics; strength of materials; shafting; boiler design; care of boilers; power of boilers; chimneys; exhaust heating; machine design; machine tools; slide valve; pulleys; cylinders and steam chests; pistons; gearing; transit surveying; triangulation; curves; radii and deflections; earth work; track work; electricity; etc.

Electrical Engineer's.—Mechanics; electrical units; physical and electrical properties of metals and alloys; temperature for copper wires; wire gauges; magnetism; dynamos and motors; electric batteries; alternating current apparatus; alternators; transformers; wattmeters; electric transmission; electric lamps; wiring; electric heating and welding; electromagnets; controllers; car wiring; etc.

Building Trades.—Loads and structures; strength of materials; properties of sections; strength of rivets and pins; materials of construction; footings and foundations; masonry construction; woods used in building; qualities of timbers; joinery; framing; estimating; elements of architectural design; drainage systems; plumbing fixtures; plumbers' tables; heating and ventilation; gas-fitting; etc.

Advertiser's.—How to plan and write an advertisement; type and type measurement; points on printing style; advertisement display; preparation of manuscript; proof reading; engraving and printing methods; electrotypes; matrices; advertisement illustrations; magazines; newspapers; retail, department-store, general, trade-paper, and mail-order advertising; trade marks; circulars; advertising agencies, etc.

Business Man's.—Arithmetic; tables; business forms; card systems; measures of extension; weight and capacity; time; value of foreign coins; duties on imports; bookkeeping; stenography; correspondence; postal information; financial terms; money and the money market; brokers and brokerage; patents; copyright and trade marks; corporations; business law; publicity; etc.

Mariners'.—Useful tables; logarithms; trigonometry; navigation; terrestrial navigation; celestial navigation; sailing distances; U. S. Navy; classification of war ships; organization of a man of war; naval ordnance; explosives; torpedoes; ship building; speed, tonnage, and fuel consumption; ropes; wind and weather; signals; nautical memoranda; U. S. naturalization laws; custom-house fees, etc.

Stenographer's & Correspondent's

Advice to beginners; shorthand speed; technical terms; commonly used foreign words and phrases; letters of application; punctuation; correct and faulty diction; business correspondence; typewriting; abbreviations; addressing; mailing; rates of postage; modern office methods; typewriting forms; duplicating work; etc.

Plumbers and Fitters'.—Arithmetic; involution and evolution; powers, roots, and reciprocals; table of circles; decimals; geometrical drawing; weights and measures; mechanical powers; blue prints; formulas; mensuration; mechanics; hydromechanics; building construction; heating and ventilation; gas and gas-fitting; plumbing; etc.

Telephone and Telegraph.—Useful tables; powers, roots, and reciprocals; mechanics; electricity; magnetism; primary batteries; storage batteries; electrical measurements; telephony; tests with magneto-generator and bell; telegraphy; Morse telegraph systems; multiplex telegraphy; simultaneous telegraphy and telephony; etc.

Bookkeeper's.—Arithmetic; formulas; tables; money; percentage; interest; equation of accounts; money and the money market; business law; financial terms; banks and banking; postal information; distances and time between various places; bookkeeping; business forms; card systems; modern office methods; cost accounting; bank bookkeeping; clearing-house methods; etc.

SPECIAL OFFER.—For a limited time we are selling these Handbooks durably bound in cloth, with gilt titles, containing on an average of 375 pages and 175 illustrations, and regularly sold at $1.25, at a price for each Handbook of . . . **50c**

International Textbook Company

Box 979 A, SCRANTON, PA.

I enclose $_____ for which please send me the books **BEFORE** which I have marked **X.**

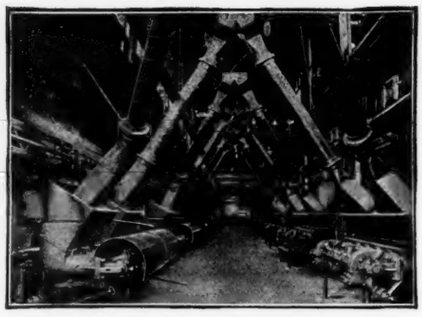
___Mechanics' Handbook	___Advertiser's Handbook
___Electrical Engineer's Handbook	___Bookkeeper's Handbook
___Building Trades Handbook	___Steno. & Corr. Handbook
___Plumbers & Fitters' Handbook	___Business Man's Handbook
___Tel. & Tel. Handbook	___Mariners' Handbook

Name _____

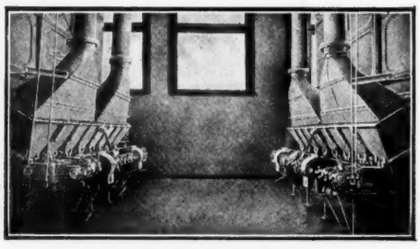
Street and No. _____

City _____ *State* _____

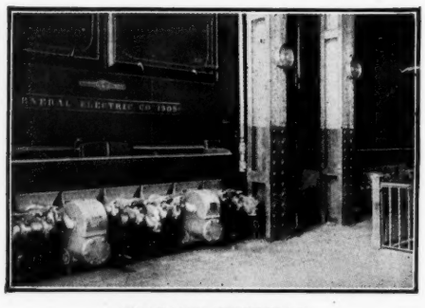
An Announcement—Not A Confession



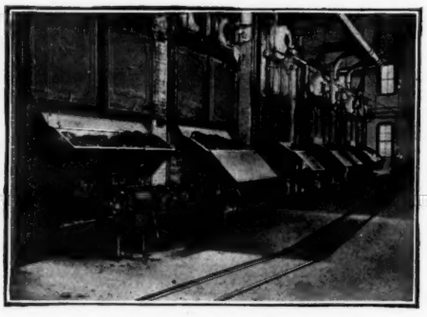
7875 H. P. TAYLOR STOKERS
At Oxford Paper Co., Rumford Falls, Me.



TAYLOR STOKERS
Old Colony Street Railway Co.,
Quincy Point, Mass.



TAYLOR STOKERS
General Elec. Co., Schenectady, N. Y.



TAYLOR STOKERS
Narragansett Brewing Co., Providence R. I.

Would you like to know the highest-priced stoker you could buy or your plant could buy?

It's the Taylor. Yes!

The Taylor Stoker

Is The Highest Priced!

Manufacturers don't make such statements about their product very often. But this is not a confession. We happen to think it is good Taylor Stoker advertising.

Here's the why behind the price:

The Taylor Stoker costs more because it's made of better material and costs more to build—

Not that it is more complicated. In fact, it is more simple. But it is built in a new way—the gravity plan, which does away for good and all with cleaning.

(The Taylor doesn't get out of order, either. It practically *can't* get out of order.)

NOW LOOK OVER THESE TAYLOR INSTALLATIONS:—

NAME	H. P.	NAME	H. P.
Dallas Elec. Light & Power Co., Dallas, Tex.	6,000	Arlington Mills, Lawrence, Mass.	4,000
N. Y. Edison Co. (Waterside Station)	52,650	Chase Rolling Mill Co., Waterbury, Conn.	1,400
N. Y. Central R. R., West Albany, N. Y.	4,000	Berlin Mills, Berlin, N. H.	4,000
Philadelphia Electric Co.	14,400	Brooklyn Edison Co.	10,000
Brooklyn Elevated Railway	10,000		

Do You Dream Firms Like These Would Buy The Highest Priced Stoker Without Reason?

They certainly would not! The bigger and more progressive a firm is, the closer it figures its costs.

But—the big firm, and the progressive firm, big or little, considers not first cost, but *all cost*. **And by the all-cost route The Taylor Stoker wins.**

The Taylor Stoker consumes the coal—all of it; it cuts ash removal cost to a minimum. It increases boiler capacity, it carrries the plant across the day's heavy peak-loads at a minimum of rated boiler horse-power. And—last, but not least—**it eliminates smoke.**

Get The Taylor Stoker Catalog Now

THE TAYLOR STOKER BUILT EXCLUSIVELY BY THE

AMERICAN ENGINEERING COMPANY

SUCCESSORS TO THE TAYLOR STOKER COMPANY, AMERICAN SHIP WINDLASS COMPANY AND WILLIAMSON BROTHERS COMPANY

MACHINISTS AND FOUNDERS
PHILADELPHIA

AMBEST
Lubricated Metallic Packing

is distinctly "The all round packing" made to work and work well under usual and unusual conditions on every valve, valve stem or rod in the plant.

Wherever there is a stuffing box, Ambest can be applied with full surety that it will hold steam tight joints and keep stems and rods working free and easy without the least danger of injury to them.

This all round serviceability is coupled with such lasting qualities that Ambest, once placed in a stuffing box, need never be removed. All that is required is to add a little more from time to time, as the very gradual wear of constant service makes it necessary.

Ambest carries its own lubricant and is made in long pliable filaments that can be easily separated and twisted into any size needed to fit any sized rod and box; it never fuses under high temperature and pressure, neither does it grow hard.

Try Ambest once and you will find that first, last and always, it loses none of the qualities that make it by far the best metallic packing you can obtain.

Fill out coupon and we will send you a Free Sample that will do more to prove its betterness than we can tell.

P. THE EUREKA PACKING CO.
NEW YORK

Gentlemen—You may send me Free Testing Sample of "AMBEST" METALLIC PACKING.

Name .....

Address .....

Firm's Name .....

"EMPIRE" PACKING — TRADE MARK

PLEASE NOTE

We are also manufacturers of the old and well-known brand of

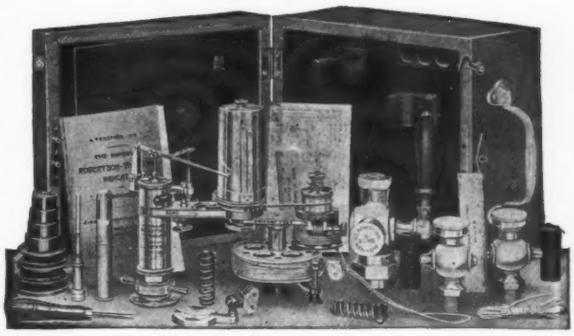
EMPIRE
Round Gum Core
PACKING

formerly made by Canfield Mfg. Co., of Philadelphia

EUREKA PACKING CO.

Jas. L. Robertson, Pres.

76-78 Murray St. New York City



The Completeness Of The Robertson-Thompson Indicator Outfit Should Appeal Strongly To You

Make success your aim, to gain as an Engineer, a higher position, higher pay. Just two words —qualify yourself.

The first step in this direction is to own and use an Indicator Outfit; it is your greatest helper and the most willing worker you could employ to push you upward.

In value, accuracy, durability, completeness and price the Robertson-Thompson Outfit stands unequalled.

No instruments are better made or are more handsome and dependable. Should any part of the Robertson-Thompson Indicator or Victor Reducing Wheel become deranged through defective workmanship or material, we will replace those parts free of cost at any time.

Send us $3.00 to show good faith and the Outfit goes to you C. O. D. for balance on a five day examination at Express Office. We will refund your money should it not be as you expected.

Outfit consists of a Robertson-Thompson Indicator and Victor Reducing Wheel, packed in a handsome hardwood case, with lock and key, nickel-plated trimmings, fitted with extra ¼" piston, detent motion, two springs as selected, either one three-way or two straight-way cocks, scales, cord, oiler, book of instructions, etc.

Fill out coupon and receive Engineers' Log Book and more details. Willis Planimeter, the finest instrument made. Price very low for cash.

Jas. L. Robertson & Sons

Jas. L. Robertson, Pres.

76-78 Murray Street, New York City

POWER 4. Send me a Free copy of the Robertson Log Book and full details of the Robertson-Thompson Indicator Outfit cash offer.

Name . . . . . .

Address . . . . . .

Firm's Name . . . . . .

Vol. 35. No. 7.

OUTLINE OF TOPICS

PLANT OF CAPITAL TRACTION COMPANY:

To meet the increased load conditions attendant upon electric traction in Washington, D. C., a new 11,000-kw. turbine plant has just been completed. J. H. Beattie.

POWER FEB. 13, 1912 Page 208

USE OF OIL IN STEAM LINES:

As means of stopping leaks oil is fed into pipes and cakes in small cracks. It also lubricates expansion joints and prevents erosion. C. F. Holley.

POWER FEB. 13, 1912 Page 211

JAMES WATT IN CORNWALL IN 1781:

Brief historical sketch of Watt's work prior to and during 1781, with a reproduction of a letter written by him during that year. Prof. W. D. Ennis.

POWER FEB. 13, 1912 Page 212

SAMUEL REYNOLDS:

A hoisting engineer for 42 years.

POWER FEB. 13, 1912 Page 214

RAISING A WATER TANK:

Ingenious method of increasing elevation of water tank on top of a brick tower. A. E. Dixon.

POWER FEB. 13, 1912 Page 214

VARIOUS TYPES OF STEAM METERS:

A description of meters in which the steam is throttled and the pressure drop utilized to indicate the flow. Prof. G. F. Gebhardt.

POWER FEB. 13, 1912 Page 215

PROGRESS IN BRITISH MARINE ENGINEERING:

Abstract of a review of 1911 appearing in the Glasgow Herald.

POWER FEB. 13, 1912 Page 218

THE GAS TURBINE:

The explosion and constant-pressure types of turbine show no advantages over the reciprocating engine and would only be useful in sizes outside of the sphere of the engine. Prof. J. Lange.

POWER FEB. 13, 1912 Page 219

CATECHISM OF ELECTRICITY:

Arc lamps of the open and closed types for both direct and alternating currents.

POWER FEB. 13, 1912 Page 222

WHY "WRONG" BEARING HEATS:

H. D. Jackson, W. A. Cooil, A. E. Kernick Page 223

ANNUAL CONVENTION OF HEATING AND VENTILATING ENGINEERS:

First meeting as one of the associated engineering societies was a decided success. Attendance large and papers presented diversified and interesting.

POWER FEB. 13, 1912 Page 224

VENTILATION PROBLEMS:

A summary of the phases of ventilation now believed to be worthy of serious study. D. D. Kimball.

POWER FEB. 13, 1912 Page 225

HEATING A SWIMMING POOL:

Construction of 3500-cu.ft. pool and equipment used to heat the water. C. Teran.

POWER FEB. 13, 1912 Page 227

EDITORIALS 231-232

Secretary Fisher on Water Power Development
Valves in Steam Lines
How the Central Station Got One Plant

READERS WITH SOMETHING TO SAY 233-235

Sampling and Analyzing Coal
Sheet Packing and Gaskets
Starting a Plant Shut Down for a Year
New Water Finder
An Inexcusable Loss
What Cracked the Ells?
Cure for a Hot Bearing
A Deranged Governor
What Changes Are Necessary?
What Caused the Rod to Wear?
Does Cold Air Cause Leaky Pipe Joints?

QUESTIONS BEFORE THE HOUSE 236-240

Erecting Steel Stacks
Home Made Damper Regulator
Brick for Boiler Walls
Water Softeners
Value of CO_2 Recorder
A Collegian's Come Back
Using the Firm's Stationery
Belt Lacing
Breakage of Separator Gage Glasses
License Laws
Value of Compression
Feed Water Regulators
Some Load
Sand for Hot Boxes
Home Made Water Heater
A Vacuum Puzzle

INQUIRIES OF GENERAL INTEREST . . . 241
NEWS 242
MOMENTS WITH THE AD. EDITOR 43
ADVERTISING INDEX 45